Trouble-shooting instructions: BMW-5023

BOSCH system : Electronic transmission control GS 1.2

Vehicle make : BMW

Basic microcard : BMW-526

TABLE OF CONTENTS

SPECIAL FEATURES

These trouble-shooting instructions, valid at the time of publication, apply to the following vehicle models:

* BMW 520i with 2.0 l / 6 cyl. as of 1.87
  BMW 525i with 2.5 l / 6 cyl. as of 1.87
  BMW 530i with 3.0 l / 6 cyl. as of 1.87
  BMW 535i with 3.5 l / 6 cyl. as of 1.87

* Electronic transmission control GS 1.2 with self-diagnosis and flashing-code output (testing with universal test adapter not required).

* The fault memory can be read out using the Pocket System Tester KTS 300 (0 684 400 300) with the program module PPG 204 as of status 09.01.89.

  Note:
  Further diagnosis possibilities (actuator diagnosis etc), which would be feasible with newer program-module statuses, are not evaluated with these vehicles.

  Pay attention to operating instructions for KTS 300. Connection of the KTS 300 to the diagnosis socket in the vehicle is via the adapter lead 1 684 463 196 (BMW).

* As an alternative to the KTS 300, the self-diagnosis can be read out by way of a flashing code (not possible with all control units).

* The self-diagnosis test table takes account of both the KTS 300 and the flashing code and is arranged according to fault-code nos. indicated by the KTS 300. In some cases, the "fault indication" column includes two types of fault which are optionally indicated by the tester, e.g.:
  Open-circuit/short-circuit to ground (= 1st type of fault)
  Short-circuit to positive (= 2nd type of fault)

SPECIAL FEATURES (CONTINUED)

* Control unit features 35-pole plug.

* EPC interface (there is no throttle-valve potentiometer with Electronic Engine-Power Control; information on the throttle-valve position is provided by the EPC control unit).

* Adaptive pressure control.
  Function:
  -Monitoring of shift times by way of compensation for disturbances such as change in coefficient of friction in multi-plate clutches, tolerances of actuators or decreasing engine power.
  -Desired/actual comparison of shift times.
  -Storage of correction values (non-volatile memory with continuous voltage supply).

If no fault is found in the transmission control, trouble-shooting is to be continued with the Motronic.

STRUCTURE AND USAGE

These brief instructions encompass essentially vehicle-specific special features and test specifications (set values).

In accordance with the customer complaint, the trouble-shooting chart leads to different causes/component faults.
For a detailed description of trouble-shooting, see the information in the trouble-shooting chart of the basic instructions.

ATTENTION: Even if reference is made to basic instructions, the set values, terminal assignments and special features of these vehicle-related brief instructions are always binding.

SAFETY AND PRECAUTIONARY MEASURES

In order to keep persons out of danger and to avoid damage to the engine, trigger boxes and control units or to the ignition system, observe the information in the basic instructions.

CAUTION!
High-performance ignition system with dangerous primary and secondary voltages!

Touching voltage-carrying components or terminals may prove fatal (both on the primary and secondary sides).

* Transmission oil:

  With automatic transmissions, even slight deviations from the specified oil level or incorrect grade of oil can lead to a noticeable deterioration in the quality of shifting. Major deviations may even result in incorrect shifting.

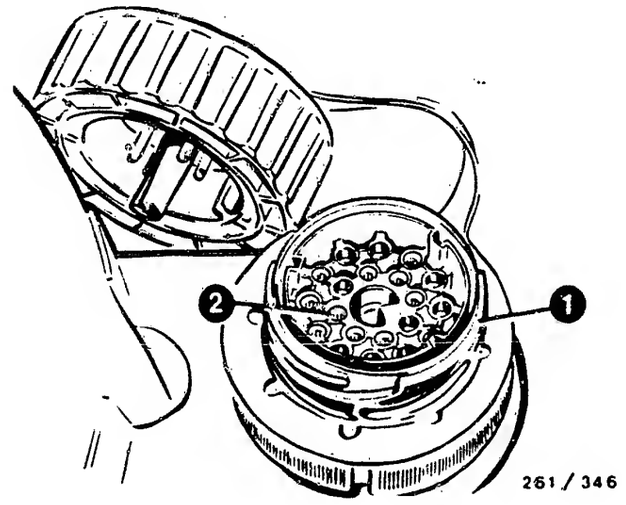
TROUBLE-SHOOTING CHART

Customer complaint (fault symptoms)

1. Fault message "transmission" in check control.	2. Engine won't start.	3. Engine dies in driving position.	4. No or faulty shift function.	5. Shift transitions not O.K.	6. No full-load shifting	7. Full-load shifting only	8. Manual shiftdown not O.K.	9. Severe jolt when engaging reverse gear	10. Not possible to shift into reverse	Cause (component fault)
*	*	*	*	*	*	*	*	*	*	Self-diagnosis
*	*									Main relay defective
*										Voltage at GS control unit
		*	*							Throttle-valve sensor
	*		*							Open-circuit at ground terminal or contact resistance
*			*							Plug at transmission dropped off or defective
	*									Starting disable relay
	*		*	*						Position switch
			*	*		*				Program button
		*								Idle contact
		*								Idle actuator
		*								Idle speed
					*					No kick-down contact
						*				Kick-down constantly grounded
*				*				*		Pressure regulator
				*						No engine intervention
			*	*						Solenoid-operated valve(s)
			*							Engine-speed sensor
		*								Converter and clutch unit does not disengage
				*						Interference
*			*	*	*	*	*	*	*	GS control unit defective
			*		*					Failure/anti-shiftdown unit

For production reasons: continued on the following coordinate.

ACTIVATION OF SELF-DIAGNOSIS



1 = Diagnosis socket
2 = Terminal no. ■

Procedure to be employed with pocket system tester KTS 300:

* When employing the pocket system tester, attention is to be paid to its operating instructions.
  Connect KTS 300 via adapter lead 1 684 463 196 (BMW) to diagnosis socket in vehicle.

Procedure to be employed when not using pocket system tester (evaluate flashing code):

* To read out the flashing code, a fault lamp (after-sales-service tool KDAW 9980: socket 1 (positive) and 2) is to be connected between connection 20 of the diagnosis socket and battery positive.

* With ignition switched off and vehicle stationary, engage driving position 1, switch on ignition and enter following program sequence within 20 seconds using the program button:
  S-program
  E-program
  S-program

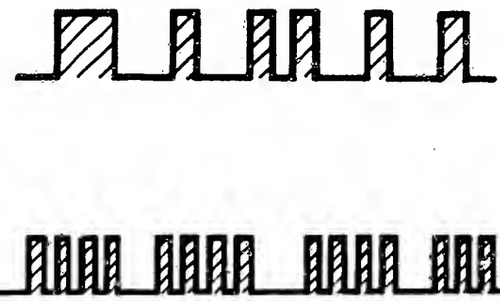
* Fault output starts with a start pulse for 2,5 seconds. After the start pulse, the first stored fault is output. This is repeated constantly. In between there is a pause of 2,5 seconds as delimitation.

* Renewed stimulation by way of entering the program sequence
  E-program
  S-program
  causes the next fault to be output etc.
  A maximum of 5 faults can be stored.

* The flashing code for each fault consists of 4 flashing-code pulse blocks. Each block represents a number and contains between 1 and 4 pulses. One pulse corresponds to the number 1, 4 pulses correspond to the number 4. The fault lamp lights up briefly with each pulse. There is a longer pause between the blocks than between the individual pulses.

* Clearing fault memory:
  Clear fault memory after eliminating the faults which have been output. To do so, disconnect control unit or negative terminal of battery for several minutes.

Top = Fault code 1211
Bottom = Flashing code 4444
(no fault stored)
Hatched pulse area =
Fault lamp lights up



260/254

SELF-DIAGNOSIS TEST TABLE

Pocket system tester Fault indication	Fault code	Flashing code	Test instructions / Test conditions	Terminals	Set values
Data exchange not possible			Prerequisite for fault output: leads to diagnosis plug/fault lamp and power supply for control unit O.K.	12 13	——
Control unit Digital sec.(comput) defective	1	1311	GS control unit defective.	—	——
Kickdown switch Short to ground	3	1121	Test switch and lead to control unit for short-circuit to ground. Kick-down switch closed in full-throttle position:	2	Approx. 0 Ω (continuity)
Program key Short to ground	4	1122	Fault: Program display does not change despite actuating program button. Test for short-circuit to ground in button and leads to control unit. Program display in instrument panel O.K.? If there are no problems with program button, leads and program display, then GS control unit is defective.	4 14 15	——
Throttle-valve signal incorrect/no signal	5	1123	Trouble-shooting without EPC: Test for open-circuit or short-circuit to ground in wiper/positive lead of throttle-valve potentiometer. Determine resistances at throttle-valve potentiometer: Pins 1/2: Pins 3/2: Trouble-shooting with EPC: Test corresponding lead between EPC and GS control unit for open-circuit and short-circuit to ground or short-circuit to positive. Test throttle-actuated-valve signal at open GS control-unit plug (term. 32) with voltmeter (switch on ignition): Continue trouble-shooting with EPC.	 9 6 7 6 32	 3... 5 k Ω 250...800 Ω and increases constantly on opening throttle valve. Voltage increases on acceleration.
Solenoid valve 1 Op.circ/grnd short	6	1211	Test solenoid-operated valve 1 and actuation lead for open-circuit (op. circ.) and short-circuit to ground. Resistance of solenoid-operated valve winding:	16	 22... 60 Ω

SELF–DIAGNOSIS TEST TABLE (CONTINUED)

Pocket system tester Fault indication	Fault code	Flashing code	Test instructions / Test conditions	Terminals	Set values
Solenoid valve 2 Op.circ/grnd short	7	1212	Test solenoid–operated valve 2 and actuation lead for open–circuit (op. circ) and short–circuits to ground Resistance of solenoid–operated valve winding:	17	22...60 Ω
Solenoid valve 1/2 Op.circ./sh. circ.	8	1213	Test actuation leads of both valves for open–circuits (op. circ.), short–circuits to ground and mutual short–circuit (short circ.)	16 17	——
Solenoid valve Reverse gear block Op.circ/grnd short	9	1214	Test solenoid–operated valve for reverse–gear block and actuation lead for open–circuit (op. circ) and short–circuits to ground: Resistance of solenoid–operated–valve winding:	20	22...60 Ω
Solenoid valve 1/ reverse gear block Op.circ./sh. circ.	10	1221	Test actuation leads of both valves for open–circuits (op. circ.), short–circuits to ground and mutual short–circuit (short circ.)	16 20	——
Solenoid valve 2/ Reverse gear block Op.circ/sh.circ.	11	1222	Test actuation leads of both valves for open–circuit (op. circ.), short–circuits to ground and mutual short–circuits (sh.circ.)	17 20	——
Solenoid valves Op.–circ./sh.circ.	12	1223	Test actuation leads of following valves for open–circuits (op.circ.), short circuits to ground and mutual short–circuits: Solenoid–operated valve 1, 2, reverse–gear block. Additionally test actuation lead of solenoid–op. valve, converter clutch for short–circ. to positive. Resistance of solenoid–operated–valve winding:	16 17 20 25	22...60 Ω
Solenoid valve Converter clutch Op.circ/grnd short	13	1224	Test sol.–op. valve for converter clutch and actuation lead for open–circuit (op. circ.) and short–circuit to ground. th Resistance of solenoid–operated–valve winding:	25	22...60 Ω
Solenoid valve 1/ Converter clutch Op.circ./sh.circ.	14	1231	Test actuation leads of both valves for open–circuits (op. circ.), short–circuits to ground and mutual short–circuit (sh.circ.)	16 25	——
Solenoid valve 2/ Converter clutch Op.circ./sh.circ.	15	1232	Test actuation leads of both valves for open–circuits (op. circ.), short–circuits to ground and mutual short–circuit (sh.circ.)	17 25	——

SELF-DIAGNOSIS TEST TABLE (CONTINUED)

Pocket system tester Fault indication	Fault code	Flashing code	Test instructions / Test conditions	Terminals	Set values
Sol. valves 1/2/ Conv.cl./Rev.gr.blk. Op.circ./sh.circ.	16	1233	Test actuation leads of following valves for open-circuits (op. circ.), short-circuits to ground and mutual short-circuits (sh. circ.): Solenoid-operated valve 1, 2, converter clutch (conv. cl.) Test actuation lead of solenoid-operated valve, reverse-gear block (Rev.gr. blk.) for short-circuit to positive. Resistance of solenoid-operated-valve winding:	16 17 25 20	 22...60 Ω
Solenoid valve conv.cl./rev.gr.blk. Op.circ./sh.circ.	17	1234	Test actuation leads of both valves for open-circuits (op. circ.), short-circuits to ground and mutual short-circuit (sh.circ.).	20 25	———
Sol. valves 1/2 Conv.cl./Rev.gr.blk. Open-circ/sh. circ	18	1241	Test actuation leads of following valves for open-circuits (op. circ.), short-circuits to ground and mutual short-circuits (sh.circ.): Solenoid-operated valve 1, reverse-gear block (Rev. gr.blk.), converter clutch (Conv. cl.). Test actuation lead of solenoid-operated valve 2 for short-circuit to positive. Resistance of solenoid-operated-valve winding:	16 20 25 17	 22...60 Ω
Sol. valves 2/1 Conv.cl./Rev.gr.blk. Op.circ./sh.circ.	19	1242	Test actuation leads of following valves for open-circuits (op. circ.), short-circuits to ground and mutual short-circuits (sh.circ.): Solenoid-operated valve 2, reverse-gear block (Rev. gr.blk.), converter clutch (Conv. cl.). Test actuation lead from solenoid-operated valve 1 for short-circuit to positive. Resistance of solenoid-operated-valve winding:	17 20 25 16	 22...60 Ω
Power supply Sol.val./press. reg. Op.circ./sh.circ.	20	1243	Test positive supply of solenoid-operated valves (sol. val.) and pressure regulator (press. reg.). Measure voltage at detached plug of transmission plug connection (connection 2) with ignition switched on:	1	Battery voltage
Eng.-speed signal incorrect/no signal	21	1131	Fault: incorrect/no Tr signal from Motronic. Test signal with engine running using oscilloscope:	21	Needle pulses

SELF-DIAGNOSIS TEST TABLE (CONTINUED)

Pocket system tester Fault indication	Fault code	Flashing code	Test instructions / Test conditions	Terminals	Set values
Pressure regulator Op.circ./sh.circ.	22	1244	Test pressure regulator and actuation lead for short-circuit to positive, short-circuit to ground and open-circuit (op. circ.). Resistance of solenoid-operated-valve winding:	22	1,7...4,5 Ω
Spark-advance angle intervention not in operation	23	1132	Fault: No or permanent ignition-angle intervention. Possible causes: Open-circuit or short-circuit to ground in lead between GS control unit term. 24 and Motronic term. 51 or Motronic control unit defective.	24	Negative rectangular pulse (on shifting gear)
Pwr. take-off sp/ downshift prevention Comparison not O.K.	24	1411	Fault: On account of an implausible output speed the anti-shiftdown unit in the control unit was activated, so as to prevent shiftdown. Resistance of output-speed sensor:	8 27	0,7...1,8 k Ω
Overspeed-prevent function active	25	1412	Fault: Engine raced or Tr signal incorrect. Possible causes: Loose contact in lead to Motronic term. 3 or Motronic control unit defective. Test signal with engine running using oscilloscope:	21	Needle pulses
Injection signal incorrect/no signal	26	1133	Fault: Incorrect or no ti signal from Motronic. Test signal with engine running using oscilloscope:	11	Injection signal
Power take-off speed/engine speed Comparison not O.K.	27	1413	Fault: Ratio of output speed to engine speed not within tolerance. Possible causes: 1. Output-speed sensor defective or lead come off. 2. Transmission-oil level below min., incorrect transmission oil or converter defective. Resistance of output-speed sensor:	8 27	0,7...1,8 k Ω
No fault stored		4444 or 1444	Continue trouble-shooting with trouble-shooting chart.	———	———

TEST SPECIFICATIONS

The stated test specifications apply to measurements directly at the component or at the 35-pin plug.

RPM sensor (in transmission): 0,7...1,8 k Ω

Pressure regulator (in transm.): 1,7...4,5 Ω

Solenoid-operated valves (in transmission)
Solenoid-operated valve-1 and solenoid-operated valve 2, reverse-gear lock and converter clutch, each: 22...60 Ω

Kick-down switch actuated: approx. 0 Ω

Selector switch in position :

	1	2	3	D	N	R	P
Term.18	UB	UB	0	0	0	UB	UB
Term.28	0	0	0	0	UB	0	UB
Term.29	UB	0	UB	0	UB	0	0
Term.30	0	0	0	UB	0	UB	0

UB = Battery voltage (switch on ignition)

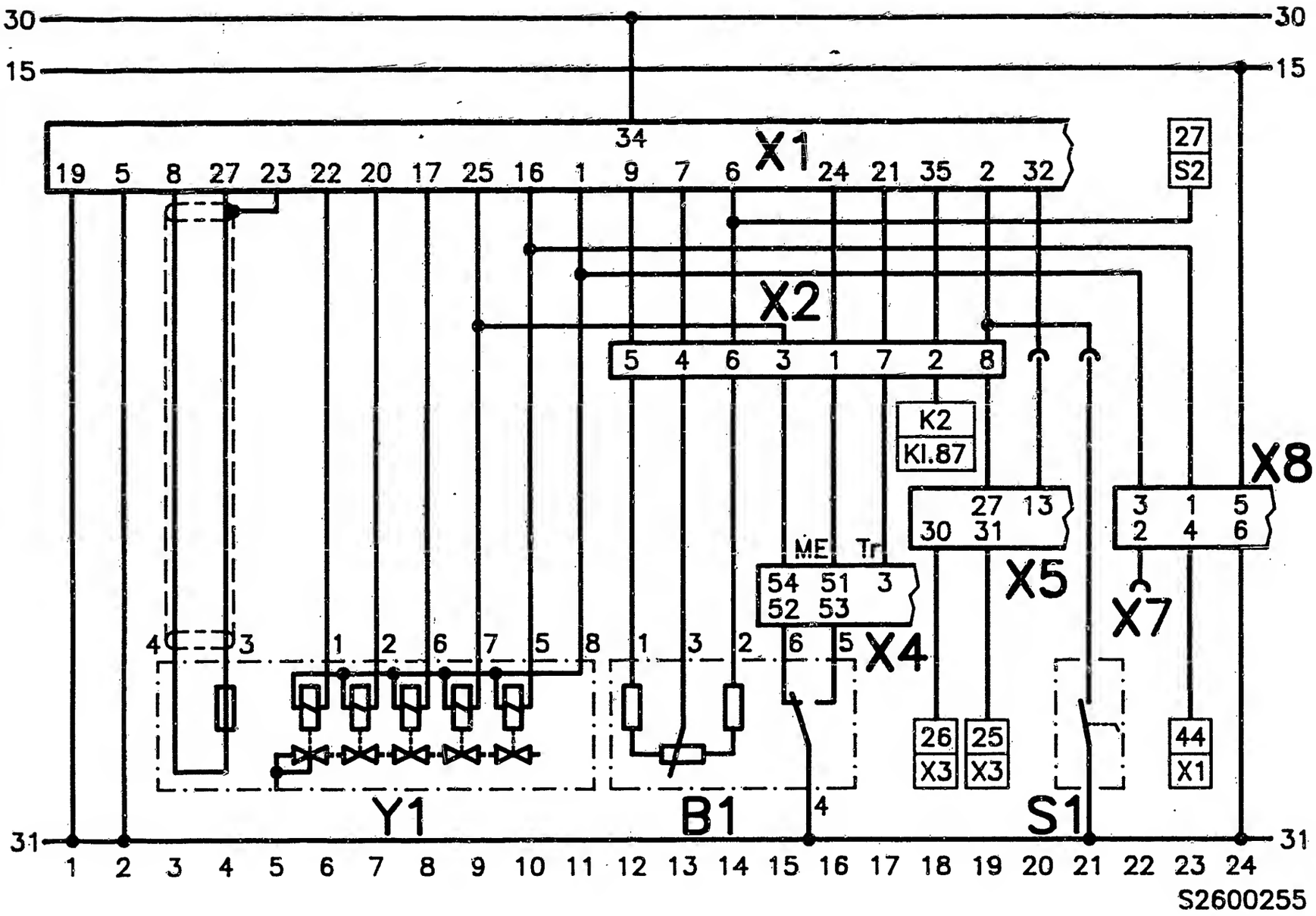
Program switch in position
S (term.4), E (term.14) and M (term.15) actuated
Resistance to ground : approx. 0 Ω in each case

Throttle-valve potentiometer:

Total resistance between pin 1 and pin 2 : 3... 5 k Ω

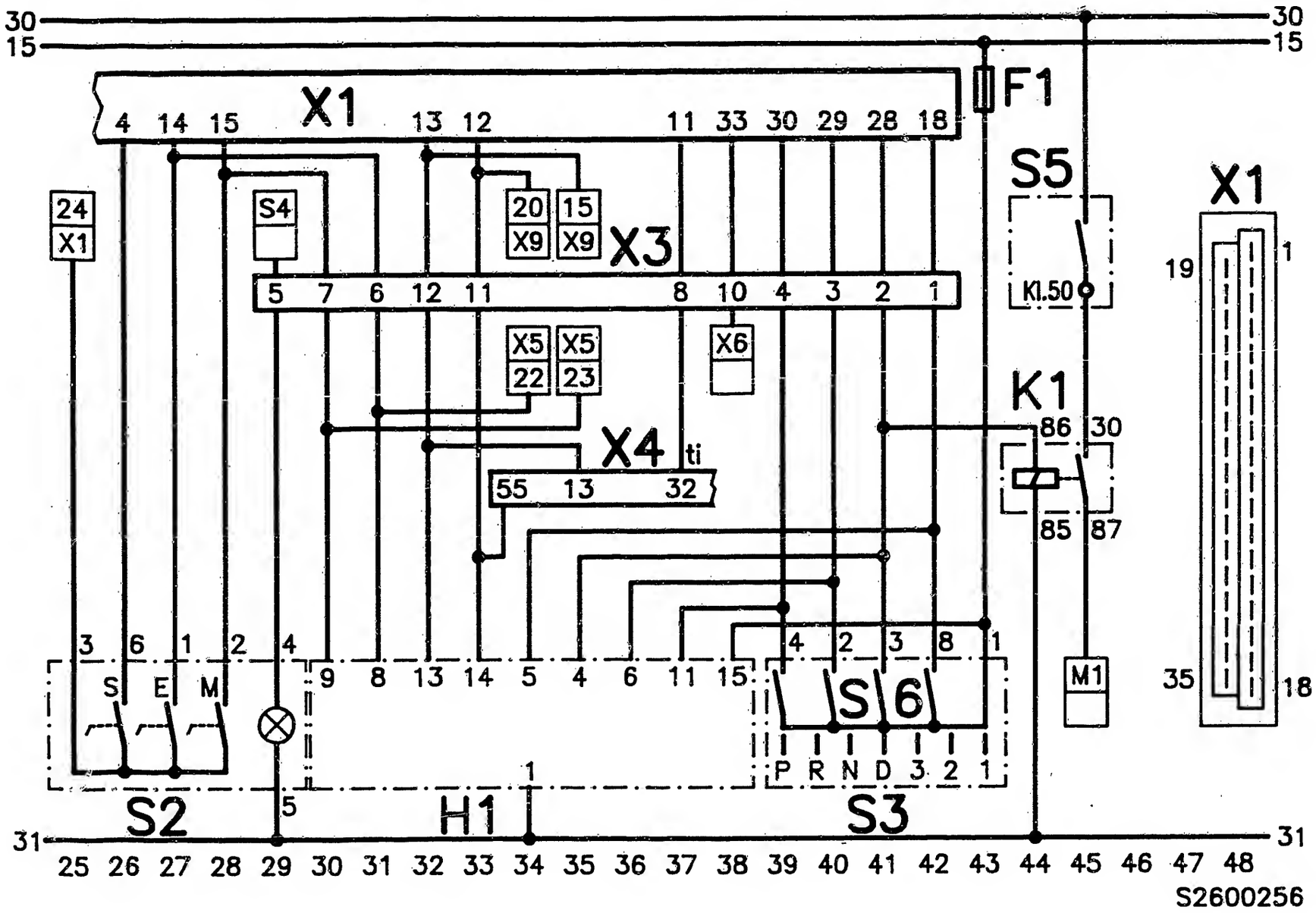
Wiper resistance between pin 3 and pin 2 (Potentiometer removed and at idle stop) : 250...800 Ω

For production reasons:
continued on the following coordinate.



ELECTRICAL TERMINAL DIAGRAM

B1 = Throttle-valve sensor
K2 = Main relay
S1 = Kick-down switch
X1 = GS control-unit plug
X2 = 8-pole Motronic plug connection (electronics box)
X3 = Plug connection to instrument wiring harness
X4 = Motronic control-unit plug
X5 = EPC control-unit plug (no B1 if EPC provided)
X7 = Connection for speedometer signal
X8 = Connector for failure/ anti-shiftdown unit
Y1 = Transmission section with switching valves, pressure regulator and engine-speed sensor (8-pole pin terminal at transmission)



ELECTRICAL TERMINAL DIAGRAM (continued)

F1 = Fuse (F17 / 7.5 A)
H1 = Instrument cluster
(with indicator for position/
and program switch)
K1 = Starting disable relay
M1 = Starting motor

S2 = Program button
S3 = Position switch
S4 = Headlamp switch
S5 = Ignition/starting switch
S6 = Switch closed in "P/N"
X1 = GS control-unit plug

X3 = Plug connection to instrument
wiring harness
X4 = Motronic control-unit plug
X6 = Check-control-module plug
X9 = Diagnosis socket

INSTALLATION POSITION OF COMPONENTS

Control unit for electronic transmission control:
In right-hand A-pillar, bottom

Failure/anti-shiftdown unit
In right-hand A-pillar, bottom

Engine-speed sensor, switching valves, pressure regulator:
In transmission

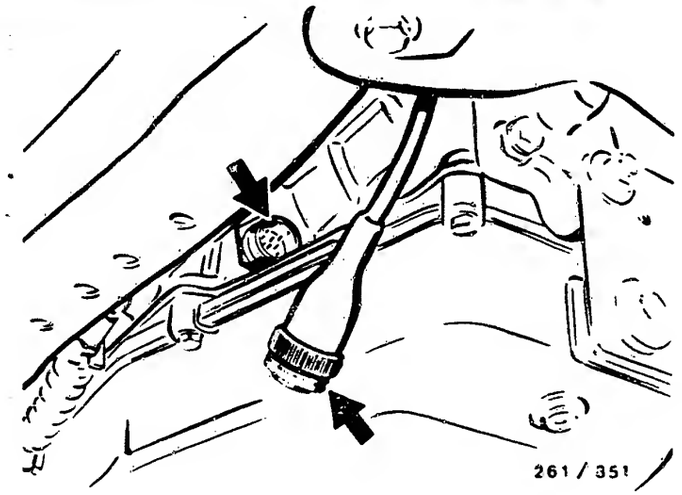
Connectors for engine-speed sensor, switching valves, pressure regulator:
At transmission (top picture; arrows)
See center picture for plug assignment

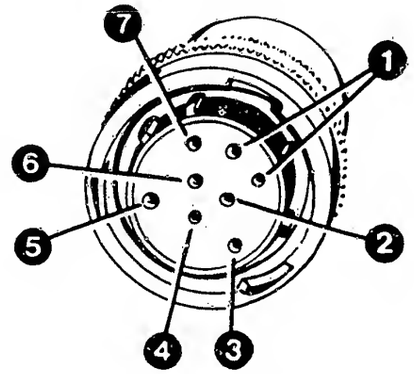
1 = Engine-speed sensor
2 = Voltage supply (10...15 V)
3 = Solenoid-operated valve 1
4 = Solenoid-operated valve 2
5 = Pressure regulator
6 = Solenoid-operated valve – converter and clutch unit
7 = Solenoid-operated valve – reverse-gear lock

Main relay for transmission control and Motronic:
In electronics box (bottom picture; Item 3)

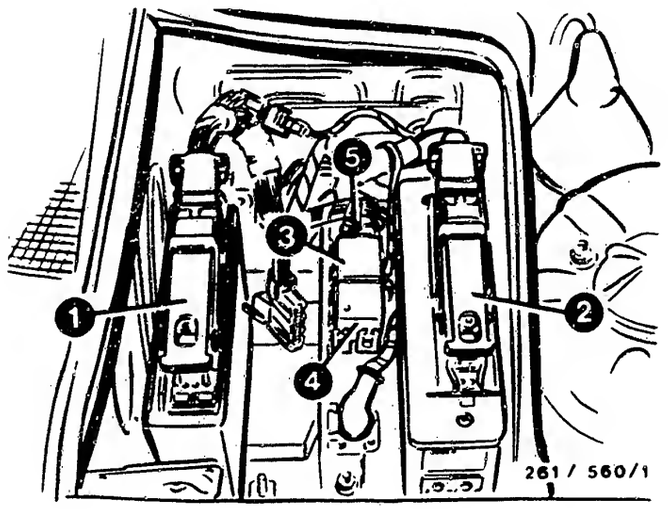
Plug connection (8-pole) for Motronic wiring harness:
In electronics box (bottom picture; Item 5)

Kick-down switch:
Beneath accelerator pedal





261/352



INSTALLATION POSITION OF COMPONENTS (CONTINUED)

Position switch:
On control console (top picture, Item 1).

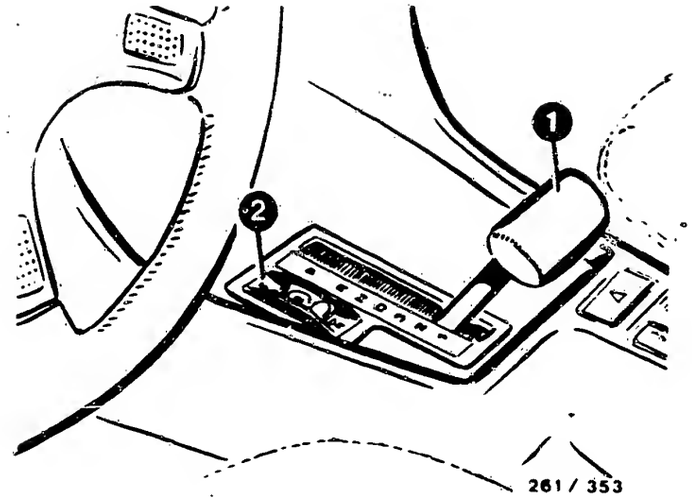
Program button:
On control console (top picture, Item 2).

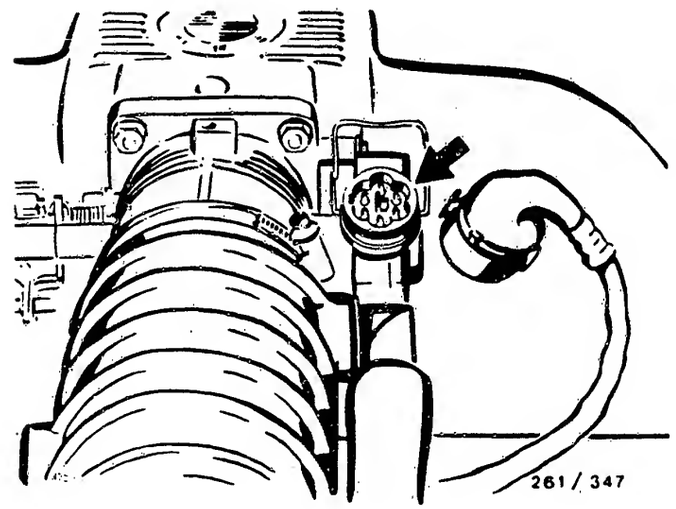
Throttle-valve potentiometer:
At throttle-valve assembly (throttle-valve stem)
520i, 525i: at bottom
530i, 535i: on side (center picture, arrow).
N o t e :
Adjustment is effected by way of idle contact. Then check voltage at plug between term. 3 and term. 2 - switch on ignition;
Accelerator pedal in off position: < 1 V
Accelerator pedal fully depressed: > 4 V

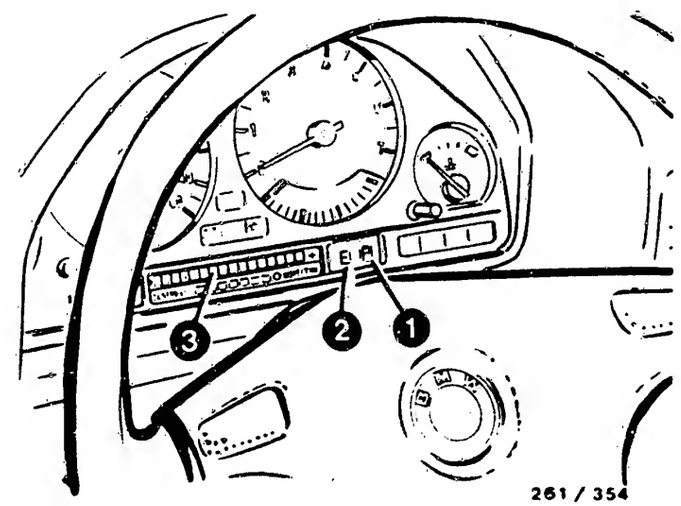
Display unit for position switch and program button:
In instrument panel (bottom picture).
1 = Position switch display
2 = Program button display

Malfunction display for electronic transmission control:
Check control; display "transmission" (bottom picture, Item 3).

Diagnosis socket:
On left of engine compartment at spring-strut dome.







Trouble-shooting instructions : OPE-5004

BOSCH system : Motronic ML 4.1

Make of vehicle : OPEL

Basic microcard : PKW-050

TABLE OF CONTENTS

SPECIAL FEATURES

These trouble-shooting instructions, valid at the time of publication, apply to the following vehicle models:

OPEL Omega 3000 (2.88 ->) and
OPEL Senator B (2.88 ->)
with 3.0 l / 6-cylinder engine, engine type CIH, C 30 NE plus with catalytic converter, 130 kW.

* Motronic ML 4.1 with self-diagnosis

* The fault memory can be read out using the Pocket System Tester KTS 300 (0 684 400 300) with the program module PPG 204 as of status 09.01.89.

  Note:
  Further diagnosis possibilities (actuator diagnosis etc), which would be feasible with newer program-module statuses, are not evaluated with these vehicles.

  Pay attention to operating instructions for KTS 300. Connection of the KTS 300 to the diagnosis socket in the vehicle is via the adapter lead 1 684 465 187 (OPEL).

* As an alternative to the KTS 300, the self-diagnosis can be read out by way of a flashing code (not possible with all control units).

* Joint sensor for engine speed and reference mark

* Single-winding rotary actuator

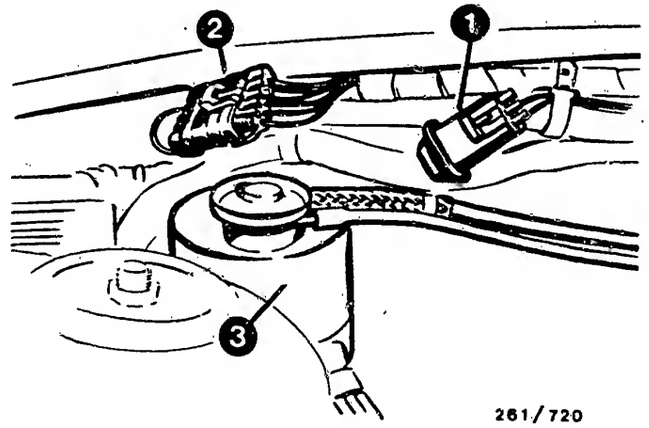
* Lambda closed-loop control

* Variant encoding for octane-number adjustment and transmission

* Variant encoding

Octane–number adjustment with encoding plug.

Octane number	Resistance at term. 15 for 3 l engine, 130 kW with regulated catalytic converter
91 RON *)	0 Ω 1)
	Infinity Ω 2)
	750 Ω 2)3)4)
95 RON	220 Ω 1)
	1200 Ω 3)
	2200 Ω 2)
	4700 Ω 2)3)



1 = Octane–rating encoding plug
2 = Diagnostic plug
3 = Activated–carbon canister

*) 91 RON = Unleaded regular fuel
(only to be used in an emergency if 95 RON not available)
95 RON = Unleaded premium fuel

1) = Basic value (black plug).
2) = Idle speed is increased by 100 min $^{-1}$.
3) = Acceleration enrichment is enriched.
4) = Advance is –5.25 °CS (retard direction) over entire map range.

* Vehicles with electronic transmission control:
When shifting gear, the electronic transmission control effects a brief ignition–timing adjustment via the Motronic control unit. This reduces the jerk when changing gear.

* Ignition distributor is used only as high–tension distributor. Adjustment necessary.

* Air–flow sensor with bypass screw (no CO potentiometer). Adjustment of bypass screw has no effect, since any incorrect setting is corrected by the adaptive lambda closed–loop control.

Vehicles with catalytic converter: term. 27 infinity Ω (open)

Vehicles without catalytic converter: term. 27 zero Ω (to ground)

Vehicles with manually shifted transmission:
term. 10 infinity Ω (open)
term. 28 zero Ω (to ground)

Vehicles with automatic transmission:
term. 10 zero Ω (to ground)
term. 28 to selection-lever positions P and N: zero Ω (via selection lever to ground). In this way, idle speed is dropped in order to prevent driving off. In all other selection-lever positions, term. 28 is open (0 Ω)

STRUCTURE AND USAGE

These brief instructions encompass essentially vehicle-specific special features and test specifications (set values).

In accordance with the customer complaint, the trouble-shooting chart leads to different causes/component faults.
For a detailed description of trouble-shooting, see the information in the trouble-shooting chart of the basic instructions.

ATTENTION: Even if reference is made to basic instructions, the set values, terminal assignments and special features of these vehicle-related brief instructions are always binding.

SAFETY AND PRECAUTIONARY MEASURES

In order to keep persons out of danger and to avoid damage to the engine, trigger boxes and control units or to the ignition system, observe the information in the basic instructions.

CAUTION!
High-performance ignition system with dangerous primary and secondary voltages!

Touching voltage-carrying components or terminals may prove fatal (both on the primary and secondary sides).

Avoid fuel injection and high-tension flashover when testing compression!
Motronic relay is therefore to be disconnected.

TROUBLE-SHOOTING CHART

Customer complaint (symptoms of trouble)

1. Starting motor operates, but engine fails to start or starts only with difficulty.	2. Engine starts but then dies.	3. Rough idling (engine speed, exhaust gas).	4. Poor throttle response, flat spot during acceleration.	5. Engine misfiring (ignition, injection).	6. Maximum engine power/top speed not reached.	7. Fuel consumption too high.	8. Engine running on (dieseling).	9. Engine pinging/knocking.	10. Engine overheating.	11. Fault lamp.	Cause (component fault)
*	*	*	*	*	*	*	*	*	*	*	Self-diagnosis
*											Voltage at control unit
*											Sensor
*		*			*	*					Fuel pressure
*		*				*	*				Solenoid-operated injection valves
		*	*								Idle contact
					*						Full-load contact
	*	*	*	*	*	*					Air-flow sensor
	*	*	*								Idle actuator
*	*	*	*								Air-induction system
		*									Idle speed
*		*		*	*						Ignition coil
*		*	*	*	*						Primary signal
		*	*	*	*	*					Secondary pattern
*	*	*	*		*	*		*	*		Ignition point
		*									Exhaust gas
		*									Overrun cut-off
		*	*	*							Interference-suppression resistors
		*	*	*							Noise test
					*						Interference

TROUBLE-SHOOTING CHART (CONTINUED)

Customer complaint (symptoms of trouble)

1. Starting motor operates but engine fails to start or starts only with difficulty.	2. Engine starts but then dies.	3. Rough idling (engine speed, exhaust gas).	4. Poor throttle response, flat spot during acceleration.	5. Engine misfiring. (ignition, injection).	6. Maximum engine power/top speed not reached.	7. Fuel consumption too high.	8. Engine running on (dieseling).	9. Engine pinging/knocking.	10. Engine overheating.	11. Fault lamp.	Cause (component fault)
				*						*	Throttle valve
				*							Fuel delivery
	*	*	*								Air bleed of tank
		*	*								Lambda closed-loop control
*	*	*	*	*	*	*		*	*	*	Control unit

SELF-DIAGNOSIS TEST TABLE

Pocket system tester Fault indication	Fault code	Flashing code	Test instructions/Test conditions	Terminals	Set values
Data exchange not possible			Ignition on: Fault lamp lights up. Prerequisite for fault output: Leads to diagnosis plug/fault lamp and power supply for control unit including term. 18 O.K. Leads and power supply O.K., but no fault output: Control unit defective.	4, 12, 17, 18	———
Lambda sensor Open circuit	13	1 3	Open-circuit in lead to lambda sensor. Sensor defective.	24	———
Engine temp. sensor Short to ground	14	1 4	Test temperature sensor and lead for short-circuit to ground (short to ground).	13	———
Engine temp. sensor Op. circ./sh. to B+	15	1 5	Test temperature sensor and leads for open-circuit (op. circ.) and short-circuit to positive (sh. to B+). Temperature-sensor resistance: at +15...+30°C : at approx. +80°C :	13, ground	 1450...3300 Ω 280....360 Ω
Lambda sensor Short to ground	44	4 4	Test lead for short-circuit to ground (short to ground). Watch out for worn cable insulation! Pronounced leaning, e.g. tank run empty.	24	———
Lambda sensor Short to B+	45	4 5	Test lead for short-circuit to positive (short to B+). Watch out for worn cable insulation! Mixture too rich.	24	———
Battery voltage too low	48	4 8	Supply voltage for control unit too low (with engine running): Test voltage dips at positive and ground terminal. Charge battery. Test alternator system.	35(+), 5(-)	Greater than 10 V
Battery voltage too high	49	4 9	Supply voltage for control unit too high (with engine running): Test alternator regulator.	35(+), 5(-)	Less than 16 V

SELF-DIAGNOSIS TEST TABLE (CONTINUED)

Pocket system tester Fault indication	Fault code	Flashing code	Test instructions/Test conditions	Terminals	Set values
Control unit Digital sec.(comput) defective	51 or 55	5 1 or 5 5	Control unit defective.	—	—
CO potentiometer Signal too low	65	6 5	Measure resistance of CO potentiometer (idle potentiometer): Test lead for short-circuit to ground. Open-circuit at term. 9. Term. 6 and term. 9 jumpered.	30	Measure resistance at air-flow sensor between term. and term. 4: Minimum 0...30 Ω Maximum: The value measured between term. 3 and term. 4 may be up to 30 Ω less. (Set value between term. 3 and term. 4: 300...550 Ω)
CO potentiometer Signal too high	66	6 6	Measure resistance of CO potentiometer (idle potentiometer): Test potentiometer and leads for open-circuit and short-circuit to positive. If there is an open-circuit at term. 6, fault code 7 4 is also displayed.	30	
Idle switch Short to ground	67	6 7	Fault: Idle contact (in throttle-valve switch) permanently closed or short-circuit to ground (short to ground) in lead. Idle contact closed in off position: Actuate throttle valve somewhat:	2, ground	Approx. 0 Ω Infinity Ω
Air-temp. sensor Short to ground	69	6 9	Test temperature sensor and lead for short-circuit to ground (short to ground).	22	—
Air-temp. sensor Open circuit	71	7 1	Test temperature sensor and leads for open-circuit. Temperature-sensor resistance: at +15°C...+30°C:	22, 6(-)	1450...3300 Ω
Full-load switch Short to ground	72	7 2	Fault: Full-load contact (in throttle-valve switch) permanently closed. Fault lamp lights up only intermittently during overrun. Full-load contact closed in full-throttle position: Release accelerator pedal somewhat:	3	0 Ω Infinity Ω

SELF-DIAGNOSIS TEST TABLE (CONTINUED)

Pocket system tester Fault indication	Fault code	Flashing code	Test instructions/Test conditions	Terminals	Set values
Air-flow sensor/ Air-mass sensor Signal too low	73	7 3	Test: Lead to air-flow sensor term. 7 for short-circuit to ground, leads to term. 7 and term. 9 for open-circuit, leads to term. 6 and term. 9 for mutual contact. Air-flow sensor defective.	6(-), 7, 9(+)	———
Air-flow sensor/ Air-mass sensor Signal too high	74	7 4	Test: Lead to air-flow sensor term. 6 for open-circuit (note: fault code 66 also appears), leads to term. 6 and term. 7 for short-circuit to positive (5 V or battery positive). Test resistances of air-flow sensor: between term. 6 and term. 7 (deflect sensor flap): between term. 6 and term. 9: Air-flow sensor defective.	6(-), 7	8...2500 Ω 300...550 Ω
Transmission identification Short to ground	75	7 5	Test lead for short-circuit to ground (short to ground) or switch (if fitted) permanently closed (faulty). Continue test with electronic transmission control.	8	———
No fault stored		1 2	Fault code 1-2 constantly repeated. Continue trouble-shooting with trouble-shooting chart.	—	———

Pressure regulator
* Fuel pressure 2,3...2,7 bar

Electric fuel pump
* Fuel delivery (measured in return line) at least 850 cm ^{3} /30s
Supply voltage (under load): at least 12 V

Temperature sensor (air)
* Internal electrical resistance measured at air-flow sensor between term. 4 and term. 5 at ambient temperature (+15°C...+30°C): 1450...3300 Ω

Temperature sensor (engine), plug color, blue.
* Internal electrical resistance at ambient temperature (+ 15° C...+ 30° C): 1450...3300 Ω
with engine at normal operating temperature (approx. + 80° C): 280....360 Ω

Solenoid-operated injection valve
* Internal electrical resistance at ambient temperature (+ 15° C...+ 30° C): 14,5.....17 Ω

Air-flow sensor
* Internal electrical resistance between:
term.2 and term.4 : 8...2500 Ω (1)
term.3 and term.4 : 300....550 Ω
term.1 and term.4 (CO potentiometer):
Minimum 0...30 Ω
Maximum: the actual value measured between term.3 and term.4 is permitted to be up to 30 Ω less.

(1) Deflect air-flow sensor flap slowly as far as it will go.
Resistance fluctuates between the terminals of the potentiometer.

Engine-speed sensor and reference-mark sensor
* Internal electrical resistance at ambient temperature (+15°C...+30°C): 400...800 Ω
* Air gap: 0,8 ±0,5 mm

Throttle-valve switch
* Resistance value of idle contact term.1 and term.2): 0 Ω
* Resistance value of full-load contact (term.1 and term.3) 0 Ω

Pressure sensor (altitude sensor)
* Total resistance between term.3(+) and term.2(-) : 2300...2500 Ω
* Resistance between wiper term.1(S) and term.2(-) : 400...2300 Ω
Test specification is altitude-dependent

Idle actuator
* Internal electrical resistance at +15°...+30°C : approx. 8 Ω

Lambda sensor
* Resistance value of heater winding 1...15 Ω

Ignition coil
* Primary resistance approx. 0 Ω
* Secondary resistance 5000...7200 Ω

Interference-suppression resistors
* High-voltage distributor rotor: 1 k Ω
The secondary side of the ignition system must be interference-suppressed with at least 5k Ω total resistance. High-voltage resistance cables are installed as standard.

TEST SPECIFICATIONS (CONTINUED)

Idle test:
Engine at normal operating temp.,
switch off consuming devices.
* Idle speed: 740 ± 40 min $^{-1}$ +)
* Spark advance: 10 ± 5 ° crankshaft +)

Automatic transmission at N or P

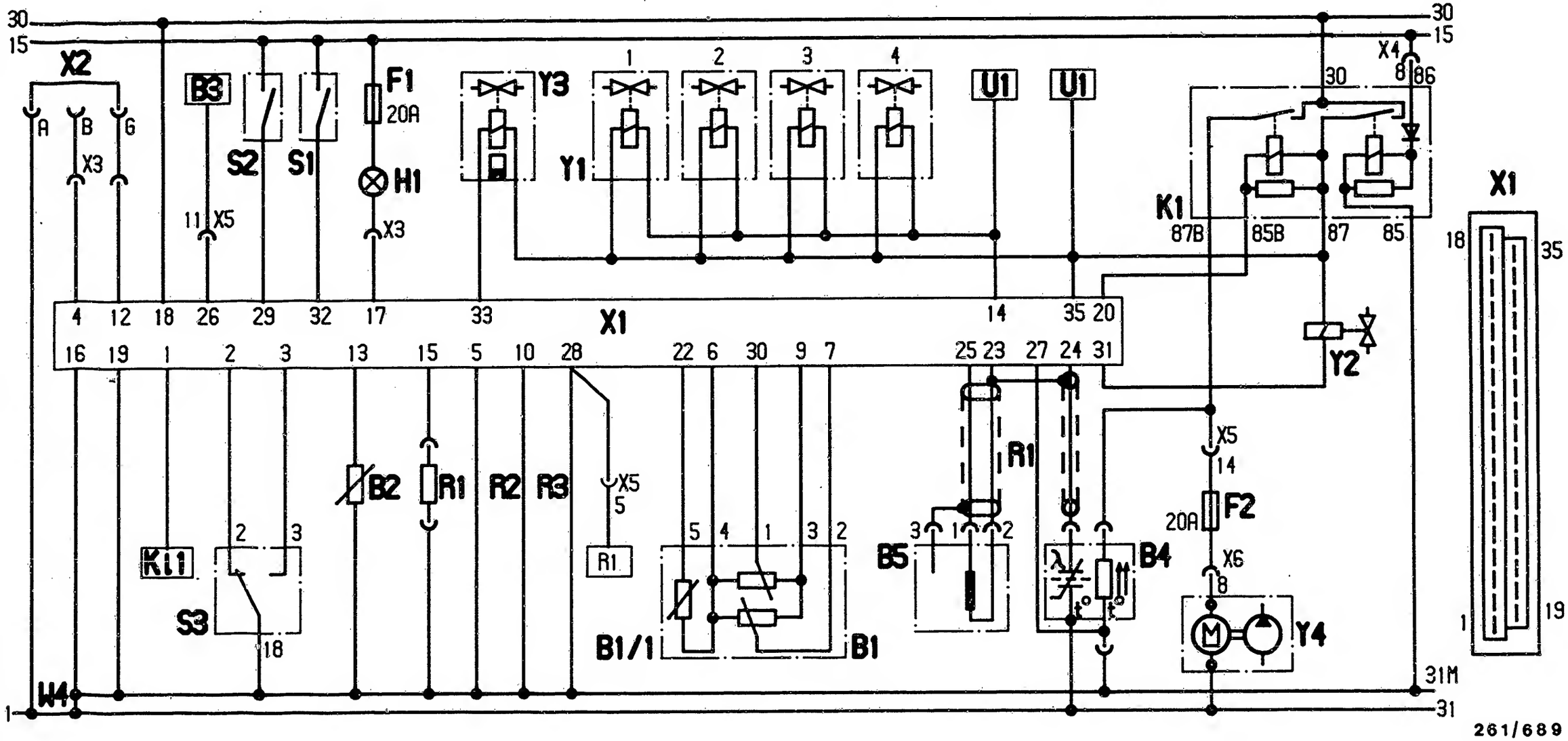
CO-content: without cat. converter
% CO by vol. 0,1...1 +)
Adjust mixture at CO
potentiometer in air-flow
sensor:
Turning counterclockwise results in a leaner mixture,
turning clockwise results in a richer mixture.
Using the potentiometer, the duration of
injection can be adjusted by max. 0,5 ms

* Catalytic-converter vehicles:: 0 % CO by vol.

+) Attention! The basic value stated may deviate due to variant coding. Observe table in "Special features" section.

See equipment and Autodata microcards for setting values for valve clearance and other engine-specific data.

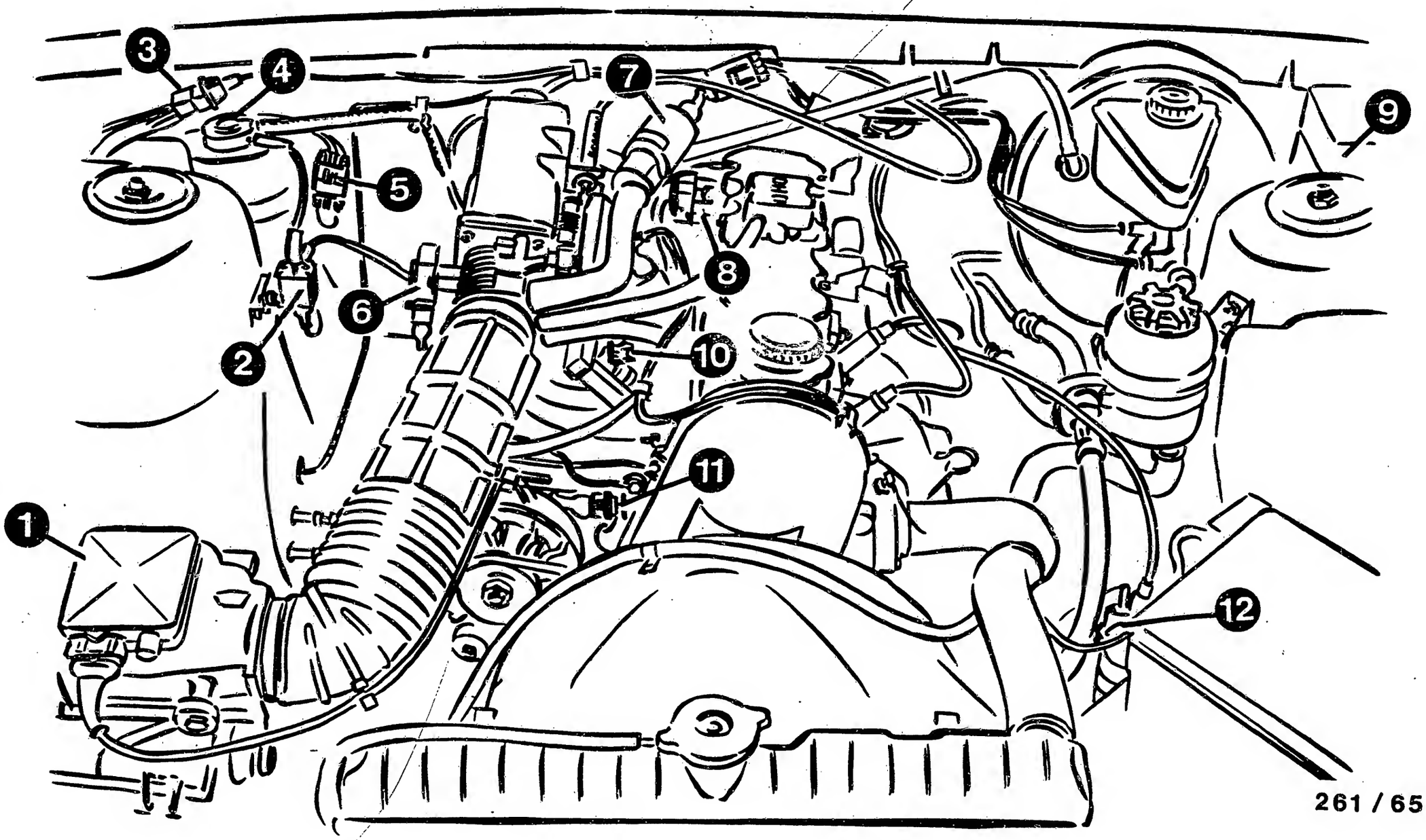
For production reasons:
continued on the following
coordinate.



ELECTRICAL TERMINAL DIAGRAM

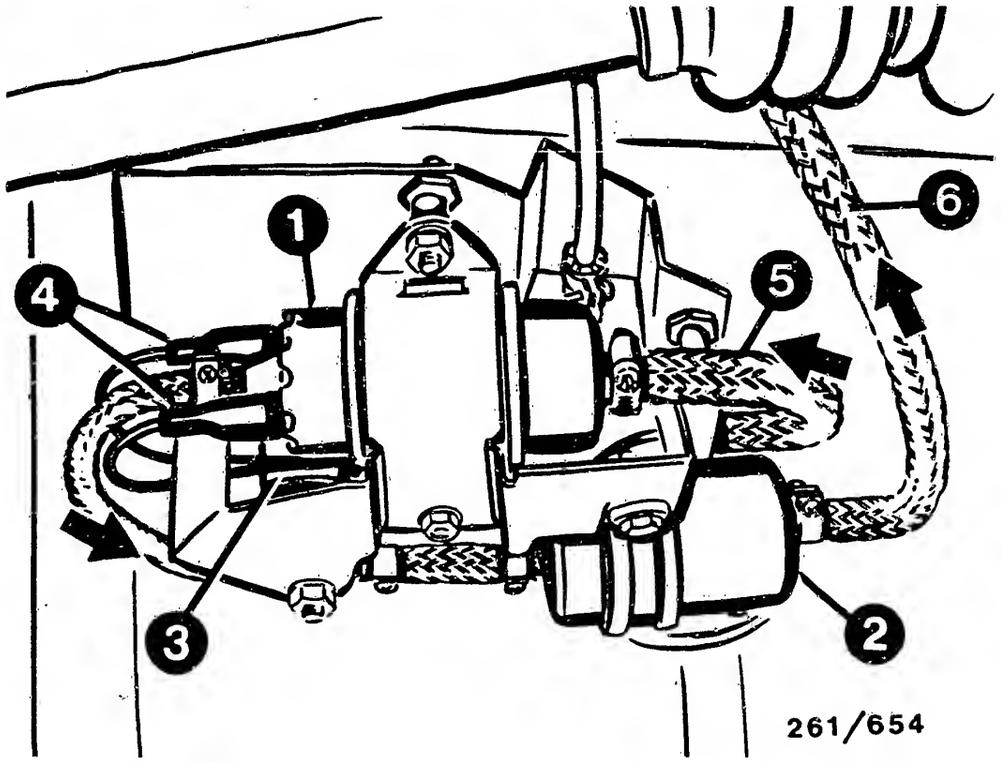
B1 = Air-flow sensor
B1/1= Temperature sensor (air)
B2 = Temperature sensor (engine)
B3 = Dist.-travelled freq. sensor
B4 = Lambda sensor
B5 = Engine-speed/ref.-mark sensor
F1,F2 = Fuse 20 A
H1 = Fault lamp
K1 = Motronic relay
K1.1= Ignition coil term. 1
R1 = see variant encoding
R2 = Automatic transmission only
R3 = Manual transmission only
S1 = A/C
S2 = Switch, compressor
S3 = Throttle-valve switch
U1 = Vehicle computer
W4 = Engine ground strap
X1 = Motronic control-unit plug
X2 = Diagnosis plug
Y1 = Injection valves
Y2 = Tank ventilation valve
Y3 = Idle actuator
Y4 = Electric fuel pump

B19 ⟹ | B20 ⟸



INSTALLATION POSITION OF COMPONENTS

1 = Air-flow sensor
2 = Tank-ventilation valve
3 = Octane-number encoding plug
4 = Active-carbon filter
5 = Diagnostic plug
6 = Throttle-valve switch
7 = Idle actuator
8 = Pressure regulator
9 = Motronic relay
10 = Injection valves
11 = Temperature sensor (engine)
12 = Ignition coil



1 = Electric fuel pump
2 = Fuel filter
3 = Pressure damper

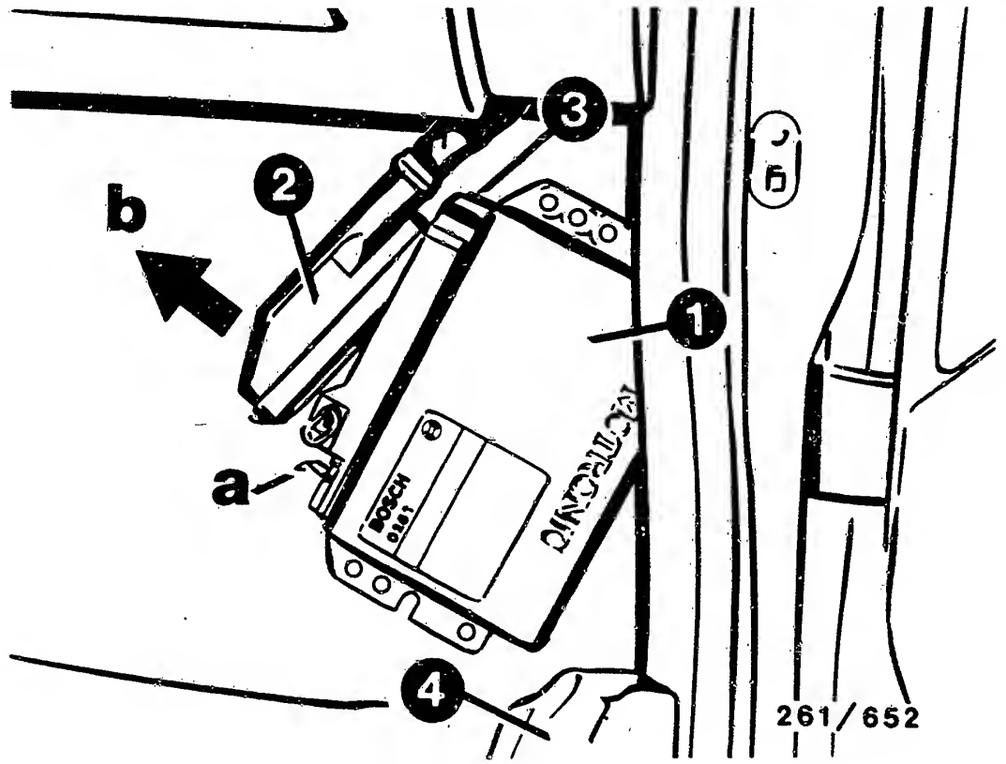
INSTALLATION POSITION OF COMPONENTS (CONTINUED)

* Electric fuel pump and fuel filter:
  In front of fuel tank.

* Ground terminals:
  On engine block at front right, under screw cover for engine oil.

* Diagnostic plug:
  In engine compartment on right on firewall.

* Octane-number encoding plug:
  In engine compartment on right on firewall.



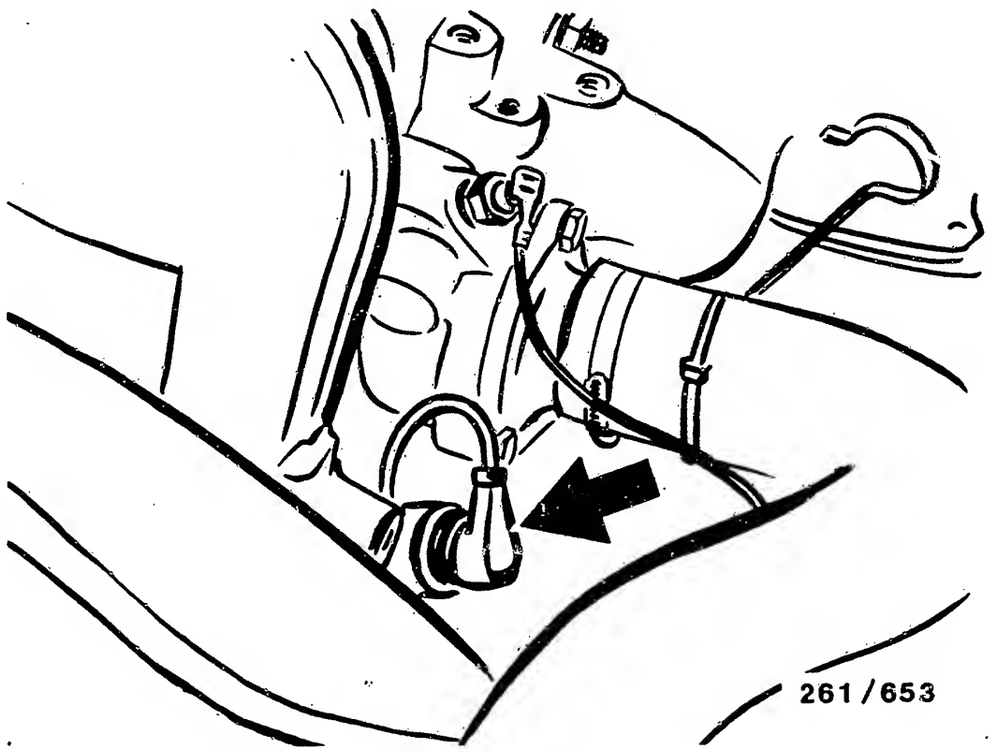
1 = Control unit
2 = Plug
3 = Mechanical encoding with locking lug
4 = Cover over door sill

INSTALLATION POSITION OF COMPONENTS (CONTINUED)

The indications "left" and "right" refer always to the forward direction of travel.

* Control unit:
  In front-passenger footwell on right-hand side. Slightly raise rubber strip and cover on door sill. Fold carpet to side and remove control-unit cover. Unscrew control unit. Unlock plug (a), hinge (arrow b) and unhook (Item 3).

* Temperature sensor (engine):
  In engine block below mounting of alternator.



Arrow = Reference-mark/engine-speed sensor

For production reasons:
continued on the following
coordinate.

INSTALLATION POSITION OF COMPONENTS (CONTINUED)

* Reference-mark/engine-speed sensor:
  In engine block at front left, below
  fastening flange.

* Lambda sensor:
  In common exhaust pipe before catalytic
  converter.

* Fuses:
  In instrument panel at bottom left.
  Fuse box can be hinged out on its lower
  side.

* Temperature sensor (air):
  In air-flow sensor

Trouble-shooting instructions: OPE-5008

BOSCH system : Electronic transmission control GS 3.1

Vehicle make : OPEL

Basic microcard : BMW-00/E121

TABLE OF CONTENTS

SPECIAL FEATURES

These trouble-shooting instructions, valid at the time of publication, apply to the following vehicle models:

* Opel Senator-B with 3.0 l / 6 cyl. as of 9.87.

* Electronic transmission control GS 3.1 (as of 01.89 GS 3.2) with self-diagnosis and flashing-code output.

* Control unit with 25-pole plug

* Control-unit no.:

with ABS		0 260 002 012
without ABS		0 260 002 013
as of 02.88 with/without ABS		0 260 002 063
as of 01.89 with/without ABS		0 260 002 068

* The fault memory can be read out using the Pocket System Tester KTS 300 (0 684 400 300) with the program module PPG 204 as of status 09.01.89.

  Note:
  Further diagnosis possibilities (actuator diagnosis etc), which would be feasible with newer program-module statuses, are not evaluated with these vehicles.

  Pay attention to operating instructions for KTS 300. Connection of the KTS 300 to the diagnosis socket in the vehicle is via the adapter lead 1 684 465 187 (Opel).

* As an alternative to the KTS 300, the self-diagnosis can be read out by way of a flashing code (not possible with all control units).

* The self-diagnosis test table takes account of both the KTS 300 and the flashing code and is arranged according to fault-code nos. indicated by the KTS 300. In some cases, the "fault indication" column includes two types of fault which can be optionally indicated by the tester, e.g.:
  Open-circuit/short-circuit to ground (= 1st type of fault)
  Short-circuit to positive (= 2nd type of fault)

SPECIAL FEATURES (CONTINUED)

* Possibility of switching from "economy" to sporty gear-shift program with program button (with engine running in Pos."D" and "2").
  Return to "economy" program effected by pressing program button again.

* Drive-off assistance (driving-off in 3rd gear) on slippery road surface by pressing winter button (with engine running in Pos."D"; indicator lamp for winter button lights up).
  Exit from the "winter program" is effected by pressing the button again or automatically (as a function of speed, load and time).

F a u l t l a m p :
The instrument panel is provided with a fault lamp (gear symbol). Its function is as follows:
Transmission indicator lamp, flashing-code indicator for self-diagnosis and indicator for sporty program.
The lamp lights up after switching on the ignition and goes out again after starting the engine.
If the fault lamp flashes, this is an indication of a fault and the limp-home program (continued driving in 3rd or in the case of control unit ...063 in 4th gear) in gear-lever position "D".
Important!
In the limp-home program a lower driving position can be manually selected irrespective of speed (anti-shiftdown unit in control unit is not active). When shifting down, there is thus a danger of overrevving the engine and/or destroying the transmission, whilst at the same time running the risk of an accident.

If no fault is found in the transmission control, continue trouble-shooting with engine management.

STRUCTURE AND USAGE

These brief instructions encompass essentially vehicle-specific special features and test specifications (set values).

In accordance with the customer complaint, the trouble-shooting chart leads to different causes/component faults.
For a detailed description of trouble-shooting, see the information in the trouble-shooting chart of the basic instructions.

ATTENTION: Even if reference is made to basic instructions, the set values, terminal assignments and special features of these vehicle-related brief instructions are always binding.

SAFETY AND PRECAUTIONARY MEASURES

In order to keep persons out of danger and to avoid damage to the engine, trigger boxes and control units or to the ignition system, observe the information in the basic instructions.

CAUTION!
High-performance ignition system with dangerous primary and secondary voltages!

Touching voltage-carrying components or terminals may prove fatal (both on the primary and secondary sides).

* Transmission oil:

  With automatic transmissions, even slight deviations from the specified oil level or incorrect grade of oil can lead to a noticeable deterioration in the quality of shifting. Major deviations may even result in incorrect shifting.

TROUBLE-SHOOTING CHART

Customer complaint (symptoms of trouble)

1. Fault lamp flashes.	2. Engine fails to start.	3. Engine stalls with drive mode selected.	4. No gear-shifting or gear-shifting not correct.	5. Gear shifts not smooth.	6. No full-load gear shifts.	7. Only full-load gear shifts.	8. No sport program.	9. Winter-mode button not functioning	10. Jerk when shifting into reverse gear.	11. Reverse gear cannot be selected.	Cause (component fault)
*	*	*	*	*	*	*	*	*	*	*	Self-diagnosis
	*										Relay set defective
			*								Voltage at transm. control unit
			*	*							Throttle-valve sensor
	*		*								Ground terminal open circuit / contact resistance
			*	*							Connection for solenoid-operated valves on transmission
	*										Starting disable relay
	*		*	*							Position switch
						*					Program button
							*				Winter-mode button
		*									Idle contact
		*									Idle actuator
		*									Idle speed
				*							No engine action
					*						No kickdown contact
						*					Kickdown constantly to ground
			*	*							Solenoid-operated valve(s)
			*								Travel pulse generator
		*									Converter clutch not releasing
			*	*							Interference
*			*	*	*	*	*	*	*		Electronic control unit defective
		*	*	*					*	*	Transmission defective

C05 — => <=

For production reasons: continued on the following coordinate.

C06 — => <=

ACTIVATION OF SELF-DIAGNOSIS:

<u>Procedure to be employed when using pocket system tester KTS 300:</u>

* Attention must be paid to the operating instructions when using the pocket system tester.
  The KTS 300 is connected to the diagnosis plug (on right of engine compartment; top picture) via the adapter lead 1 684 465 187 (Opel).

<u>Procedure to be employed when not using the pocket system tester (flashing code evaluation):</u>

* Switch on ignition or run engine.
* Detach diagnosis protection plug from diagnosis connector (on right of engine compartment; top picture).
* Short sockets A (ground) and C (top picture).
* Fault lamp in instrument panel starts to flash.

Flashing code evaluation:
The flashing code for each fault consists of two flashing-pulse blocks. Each block represents a number and contains 1 to 9 pulses. One pulse corresponds to the number 1, 9 pulses correspond to the number 9. The fault lamp lights up briefly with each pulse. The pause between the blocks is longer than that between the individual pulses. There is an even longer pause (approx. 3 seconds) between two fault codes.

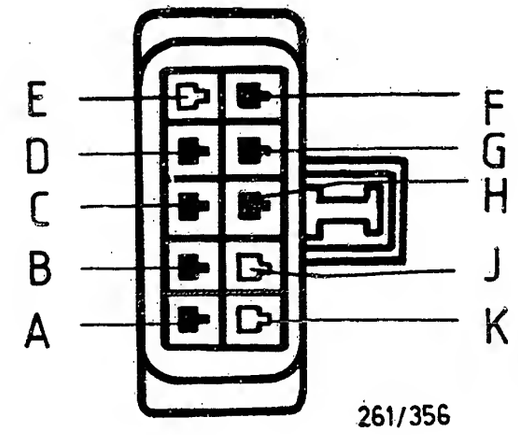
Diagnosis output always commences with the start code 1 2.
This flashing code is repeated at least 3 times. It indicates that the diagnosis output is functioning. If there is no fault stored in the control unit, the flashing code 1 2 is constantly repeated.

If there is a fault stored in the control unit, the first fault is output 1 2 times following the flashing code 3. If a further fault is stored, its flashing code likewise follows 3 times.

Up to a maximum of 5 faults can be stored. Following output of the last fault, the flashing code starts again with 1 2 etc.

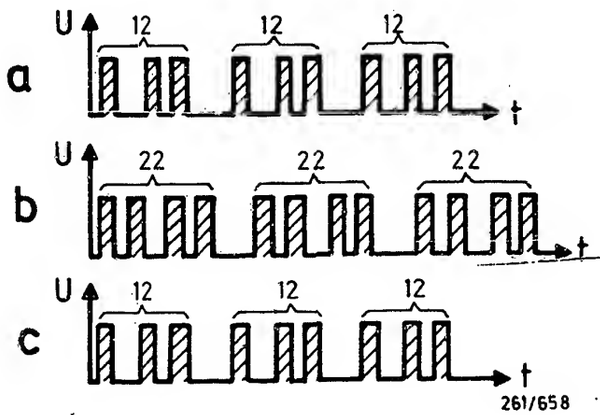
Diagnosis output is terminated by disconnecting the connection at the diagnosis plug or switching off the ignition.

The fault memory in the control unit is cleared if the battery or the GS control unit is disconnected for min. 10 seconds or if the ignition is switched off and on more than 20 times.



Top view of diagnostic plug

a = c = Flashing code 1 – 2
b = Fault code 2 – 2
Shaded pulse area = Fault lamp lit



SELF-DIAGNOSIS TEST TABLE

Pocket system tester Fault indication	Fault code	Flashing code	Test instructions/Test conditions	Terminals	Set values
Data exchange not possible			Prerequisite for fault output: Leads to diagnosis plug/fault lamp and power supply for control unit O.K.	3 16	—
Solenoid valve 1 Short to ground	17	17	Test solenoid-operated valve 1 and actuation lead for open-circuit/short-circuit to ground (short to ground). Resistance of solenoid-operated-valve winding:	 14	 8...20 Ω
Solenoid valve 1/2 Short circuit	18	18	Test actuation leads of both valves for mutual short-circuit.	14 15	
Solenoid valve 1/ Converter clutch Short circuit	19	19	Test actuation leads of both valves for mutual short-circuit.	14 17	
Throttle-valve signal Signal too high	21	21	Determine voltages at throttle-valve potentiometer. Push back rubber sleeve of potentiometer plug and measure voltage with test prods (switch on ignition). Term. 1/2: Term. 3/2 with throttle valve closed: Term. 3/2 (accelerate slowly up to full throttle): Possible causes: Wiper lead short-circuited with positive lead of sensor or open-circuit in ground lead.	 24 11 23 11 23 11	 4.5...5.5 V 0,45...0,75 V Voltage increases without dips up to min. 4,2 V.
Throttle-valve signal Signal too low	22	22	Determine voltages at throttle-valve potentiometer as for fault code 33. Possible causes: Test wiper/positive lead of throttle-valve potentiometer for open-circuit or short-circuit to ground.		
Power take-off speed sensor incorrect/no signal	24	24	Fault: failure of signal. Test sensor (Hall generator) and leads (including sensor power supply) for open-circuit and short-circuits. Signal of output-speed sensor (rear axle must turn):	 25	 Rectangular signal

SELF-DIAGNOSIS TEST TABLE (CONTINUED)

Pocket system tester Fault indication	Fault code	Flashing code	Test instructions/Test conditions	Terminals	Set values
Solenoid valve 1 Op. circ./sh. to B+	25	25	Test solenoid-operated valve 1 and actuation lead for open-circuit (op. circ.) or short-circuit to positive. (sh. to B+). Resistance of solenoid-operated-valve winding:	14	8...20 Ω
Solenoid valve 2 Short to ground	26	26	Test solenoid-operated valve 2 and actuation lead for short-circuit to ground (short to ground). Resistance of solenoid-operated-valve winding:	15	8...20 Ω
Solenoid valve 2/ Converter clutch Short circuit	27	27	Test actuation leads of both valves for mutual short-circuit.	15 17	—
Solenoid valve 2 Op.circ./sh. to B+	28	28	Test actuation leads of both valves for open-circuit (op. circ.), short-circuit to ground and mutual short-circuit. Resistance of solenoid-operated-valve winding:	15	8...20 Ω
Solenoid valve Converter clutch Short to ground	29	29	Test solenoid-operated valve for converter clutch and actuation lead for short-circuit to ground (short to ground). Resistance of solenoid-operated-valve winding:	17	8...20 Ω
Eng.-speed signal incorrect/no signal	31	31	Fault: Incorrect or no TD signal from Motronic (without cat.: from ignition) Test signal with oscilloscope with engine running:	19	Rectangular pulses
Solenoid valve Converter clutch Op. circ./sh. to B+	36	36	Test solenoid-operated valve for converter clutch and actuation lead for open-circuit (op. circ.) and short-circuit to positive (sh. to B+). Resistance of solenoid-operated-valve winding:	17	8...20 Ω
3-2 downshift prevention function active	46	46	3-2 shiftdown had to be prevented by control unit on account of incorrect or no output-speed information. Most frequent cause of fault: Open-circuit in lead(s) between output-speed sensor and control unit.	—	—
4-2 downshift prevention function active	47	47	As for fault code 70, however affects 4-2 shiftdown.	—	—

SELF-DIAGNOSIS TEST TABLE (CONTINUED)

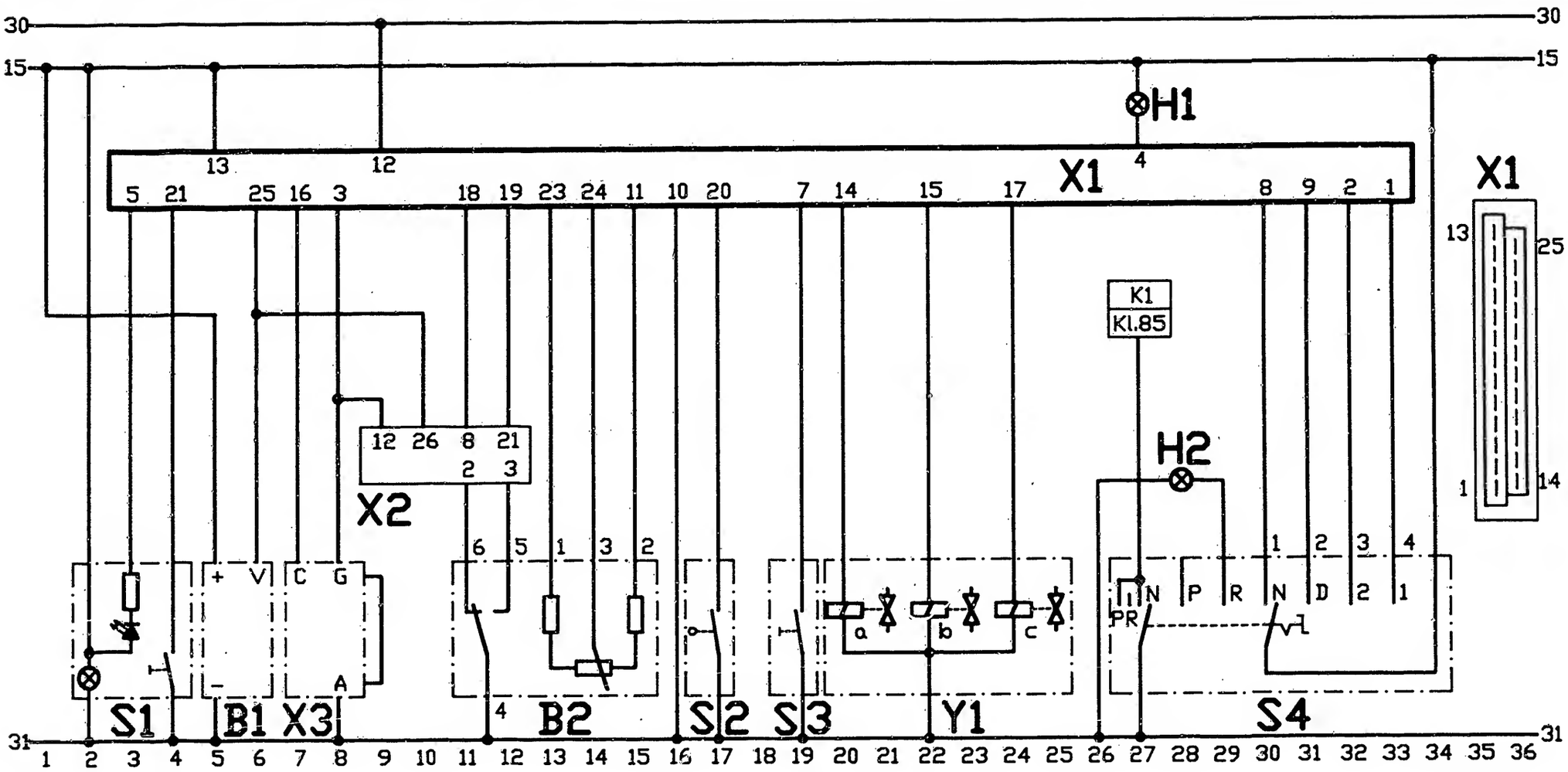
Pocket system tester Fault indication	Fault code	Flashing code	Test instructions/Test conditions	Terminals	Set values
Control unit Digital sec.(comput) defective	55	55	GS control unit defective.	—	—
Position switch Open circuit	56	56	Position switch (selector lever) incorrectly adjusted or defective, or open-circuit in lead(s), or loose contact. Measure voltages at open GS control-unit plug and with ignition switched on in selector-lever positions 1, 2, D and N in accordance with circuit diagram:	1 2 9 8	Depending on battery voltage
Spk.-advance ang. intervention interf. Op.circ/grnd short	75	75	Open-circuit (op. circ.) in lead to Motronic term. 8, or short-circuit to ground, or Motronic control unit (input - ignition-map switch) or GS control unit (output stage) defective.	18	Negative rectangular pulse (when changing gear)
Kickdown switch Short to ground	77	77	Test switch and lead to control unit for short-circuit to ground (short to ground). Kickdown switch closed in full-throttle position:	20	Approx. 0 Ω (continuity)
Operating time exceeded	78	78	Fault: Operating times too long. Possible causes: 1. No ignition-angle intervention active (control-unit fault). 2. Transmission fault (e.g. incorrect transmission oil, multi-plate clutches defective or worn)	—	—

TEST SPECIFICATIONS

The test specifications stated apply to measurements taken directly at the component or at the 25-pin plug.

Voltage supply for travel pulse generator (Hall generator):	Greater than 10 V
Solenoid-op. valves (in transm.) MV-1, MV-2, MV-WK (converter clutch) Resistance to ground, each:	8...20 Ω
Kickdown switch actuated Resistance to ground:	Approx.0 Ω
Position switch in position 1, 2, D, N : each time battery voltage to the corresponding control-unit-plug terminals with ignition switched on.	
Program button (in selection lever) actuated Term. 7 in control-unit plug; resistance to ground:	Approx. 0 Ω
Winter-mode button actuated Term. 21 in control-unit plug; resistance to ground:	Approx. 0 Ω
Throttle-valve potentiometer	
Total resistance between pin 1 and pin 2 :	3...5 k Ω
Wiper resistance between pin 3 and pin 2 (potentiometer at idle stop):	250...800 Ω

For production reasons: continued on the following coordinate.



ELECTRICAL TERMINAL DIAGRAM

B1 = Travel pulse generator
B2 = Throttle-valve sensor
H1 = Fault lamp
H2 = Backup lamp
K1 = Starting disable relay
S1 = Winter-mode button with indic. lamp
S2 = Kickdown switch
S3 = Program button
S4 = Position switch
X1 = Electronic-control-unit plug
X2 = Motronic control-unit plug
X3 = Self-diagnosis plug
Y1 = Transm. unit with switching valves
a = Solenoid-operated valve 1
b = Solenoid-operated valve 2
c = Converter-clutch solenoid-operated valve

INSTALLATION POSITION OF COMPONENTS

Control unit for electronic transmission control:

In the engine compartment between the right-hand McPherson-strut dome and firewall (upper illustration, arrow)

Solenoid-operated valves for gear-shifting and converter clutch:

In the transmission

Connection for solenoid-operated valves:

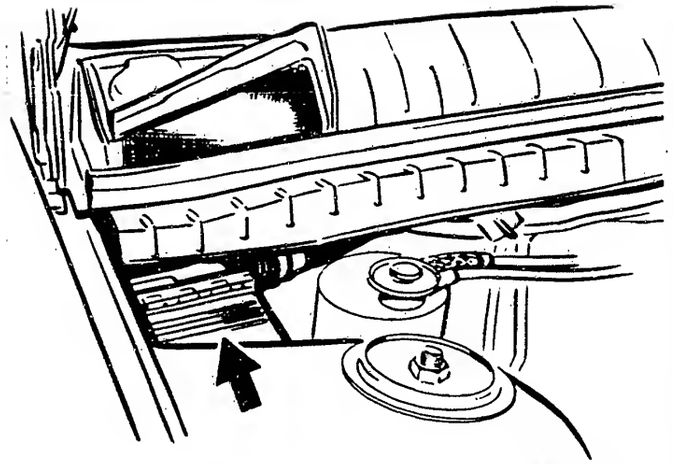
On the transmission on the left (center illustration, arrow)

Travel pulse generator:

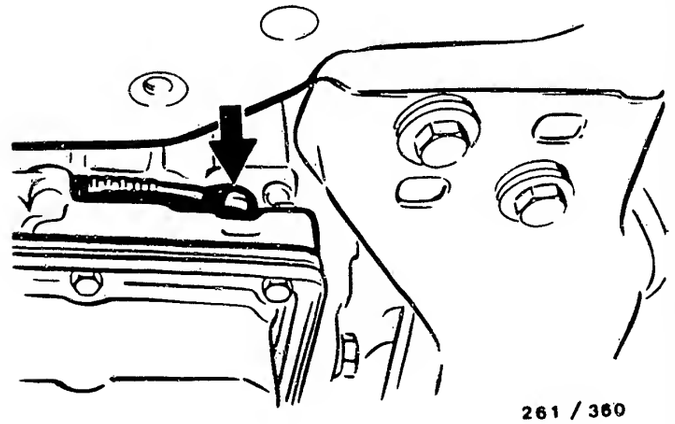
At transmission output (lower illustration,)

Kickdown switch:

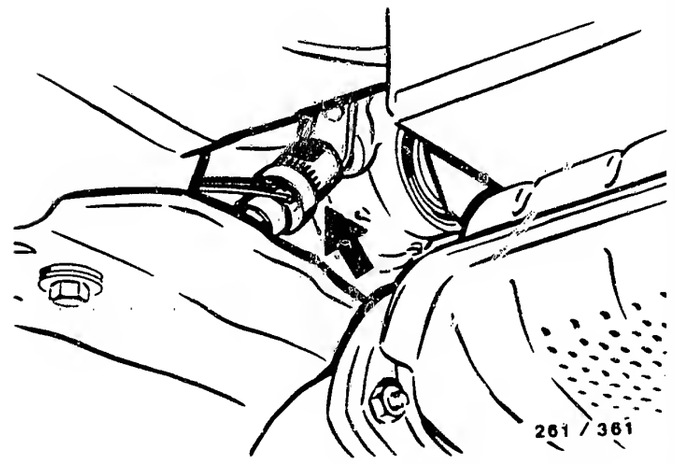
Under accelerator pedal



261/359



261/360



261/361

INSTALLATION POSITION OF COMPONENTS (Continued)

Position switch:

On control console (upper illustration, Item 1)

Winter-mode button with indicator lamp:

On control console (upper illustration, Item 2 and Item 3)

Program button:

On the selection lever (upper illustration, Item 4)

See upper illustration : 1 = Position switch with selection lever
2 = Winter-mode button
3 = Indicator lamp for winter-mode button
4 = Program button

Fault lamp:

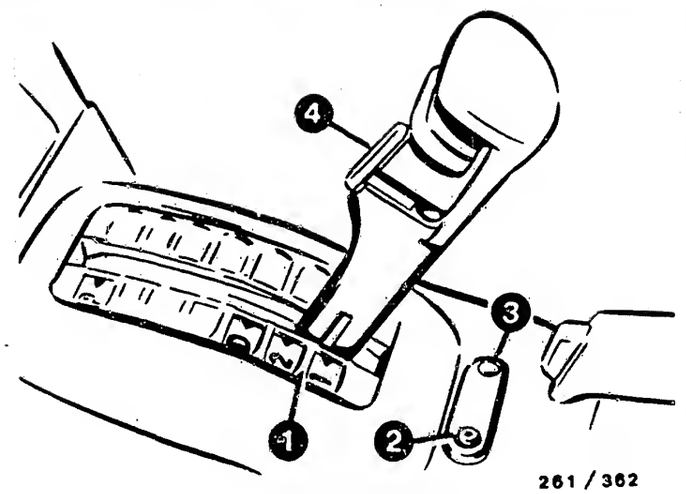
In the instrument-lamp strip (toothed-gear symbol)
(center illustration, arrow)

Throttle-valve sensor:

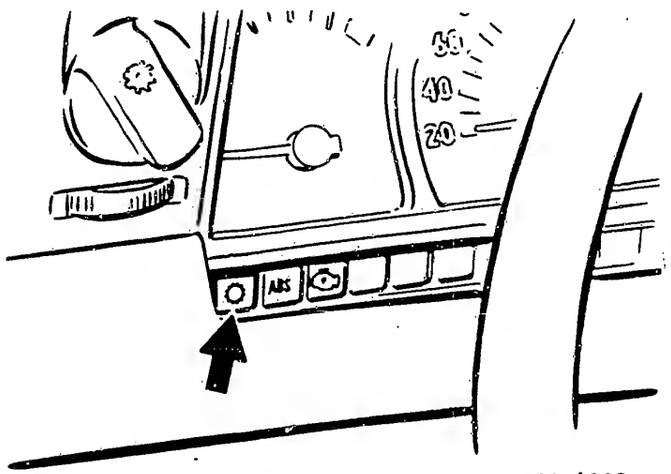
On the throttle-valve assembly (lower illustration, arrow)

N O T E:

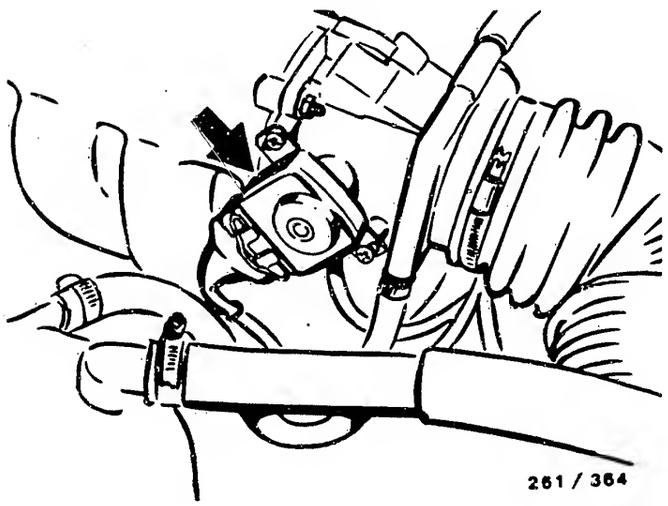
Adjust by means of the idle contact and then check voltage at plug between term. 3 and term. 2 - switch on ignition; accelerator pedal in rest position: 0.45...0.75 V
accelerator pedal pushed to floor: greater than 4.20 V



261/362



261/363


261/364

Diagnostic plug:

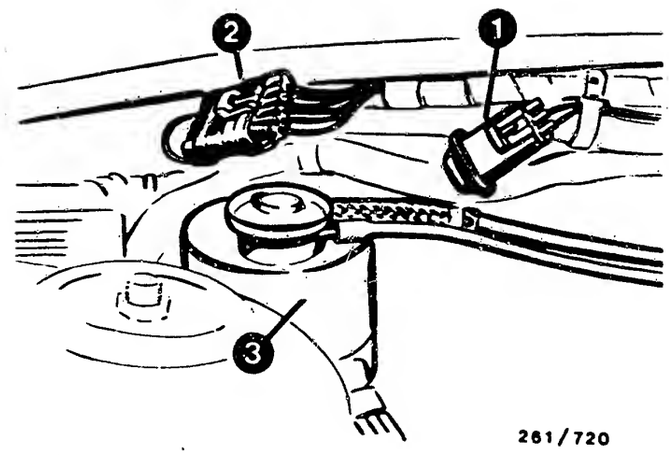
Near to the electronic control unit (upper illustration, Item 2)

Relay set for transmission control and Motronic:

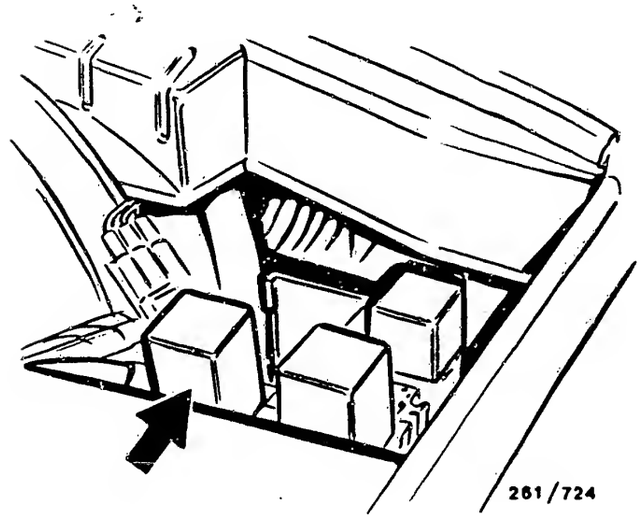
In the engine compartment between the left-hand McPherson-strut dome and the firewall (center illustration, arrow)

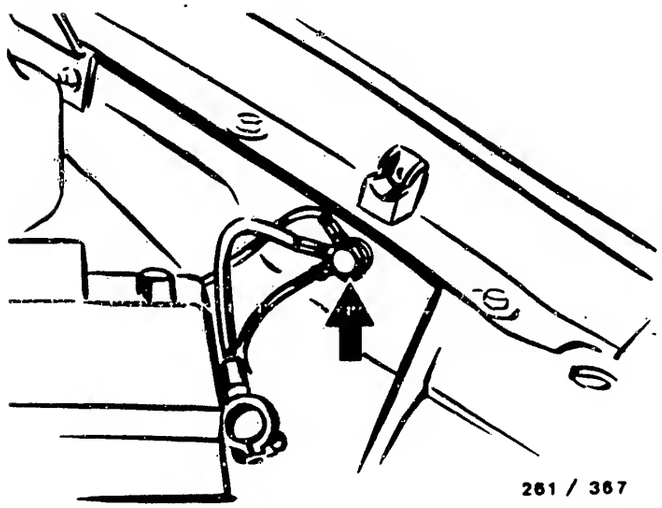
Ground terminal:

Next to the battery (lower illustration, arrow)



261/720


261/724


261 / 367

Trouble-shooting instructions : OPE-5009

BOSCH system : Motronic ML 4.1

Make of vehicle : OPEL

Basic microcard : PKW-050

TABLE OF CONTENTS

SPECIAL FEATURES

These trouble-shooting instructions, valid at the time of publication, apply to the following vehicle models:

* OPEL Omega
  with 2.0 l / 4-cylinder engine,
  engine type OHC, C 20 NE and 20 SE
  (10.86 ->)

* Motronic ML 4.1 with self-diagnosis

* The fault memory can be read out using the Pocket System Tester KTS 300 (0 684 400 300) with the program module PPG 204 as of status 09.01.89.

  Note:
  Further diagnosis possibilities (actuator diagnosis etc), which would be feasible with newer program-module statuses, are not evaluated with these vehicles.

  Pay attention to operating instructions for KTS 300. Connection of the KTS 300 to the diagnosis socket in the vehicle is via the adapter lead 1 684 465 187 (OPEL).

* As an alternative to the KTS 300, the self-diagnosis can be read out by way of a flashing code (not possible with all control units).

* Joint sensor for engine speed and reference mark

* Single-winding rotary actuator

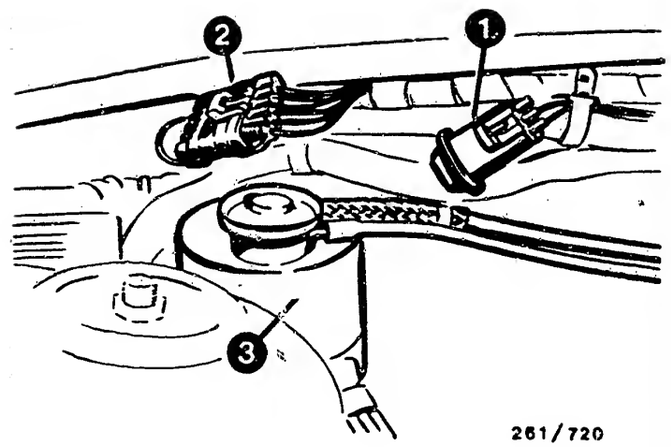
* Lambda closed-loop control

* Variant encoding for octane-number adjustment and transmission

Variant encoding

Octane-rating adaptation with encoding plug (black plug).

Octane rating	Resistance at term. 15 for 3 l engine, 115 kW with catalytic convert. with closed-loop cont.
91 RON *)	0 Ω 1)
	Infinity Ω 2)
	750 Ω 2)3)4)
95 RON	220 Ω 1)
	1200 Ω 3)
	2200 Ω 2)
	4700 Ω 2)3)
	—



1 = Octane-rating encoding plug
2 = Diagnostic plug
3 = Activated-carbon canister

*) 91 RON = unleaded regular gasoline (used only in case of emergency if no 95 RON gasoline is available).

95 RON = unleaded premium gasoline

1) Basic value
2) Idle speed is raised by 100 min^{-1} .
3) Acceleration enrichment is enriched.
4) Spark advance amounts to −5.25 ° crankshaft (retardation) throughout the whole characteristic-map range.

Vehicles with catalytic converter: term. 27 infinity Ω (open)

Vehicles without catalytic converter: term. 27 zero Ω (to ground)

Vehicles with manually shifted transmission:
term. 10 infinity Ω (open)
term. 28 zero Ω (to ground)

Vehicles with automatic transmission:
term. 10 zero Ω (to ground)
term. 28 to selection-lever position P and N: zero Ω (via selection lever to ground).
In this way, idle speed is dropped in order to prevent driving off. In all other selection-lever positions, term. 28 is open (0 Ω)

Vehicles with air conditioner:
term. 29 to switch for defroster lever (air-conditioner readiness for operation).
Term. 32 to switch for compressor.

Vehicles with distance-travel frequency sensor (speedometer signal):
term. 26 connected to distance-travel frequency sensor.
Distance-travel frequency sensor is installed only in conjunction with on-board computer, LCD instrument or electronic speedometer.

STRUCTURE AND USAGE

These brief instructions encompass essentially vehicle-specific special features and test specifications (set values).

In accordance with the customer complaint, the trouble-shooting chart leads to different causes/component faults.
For a detailed description of trouble-shooting, see the information in the trouble-shooting chart of the basic instructions.

ATTENTION: Even if reference is made to basic instructions, the set values, terminal assignments and special features of these vehicle-related brief instructions are always binding.

SAFETY AND PRECAUTIONARY MEASURES

In order to keep persons out of danger and to avoid damage to the engine, trigger boxes and control units or to the ignition system, observe the information in the basic instructions.

CAUTION!
High-performance ignition system with dangerous primary and secondary voltages!

Touching voltage-carrying components or terminals may prove fatal (both on the primary and secondary sides).

Avoid fuel injection and high-tension flashover when testing compression!
Motronic relay is therefore to be disconnected.

TROUBLE–SHOOTING CHART

Customer complaint (symptoms of trouble)

1. Starting motor operates, but engine fails to start or starts only with difficulty.	2. Engine starts but then dies.	3. Rough idling (engine speed, exhaust gas).	4. Poor throttle response, flat spot during acceleration.	5. Engine misfiring (ignition, injection).	6. Maximum engine power/top speed not reached.	7. Fuel consumption too high.	8. Engine running on (dieseling).	9. Engine pinging/knocking.	10. Engine overheating.	11. Fault lamp.	Cause (component fault)
*	*	*	*	*	*	*	*	*	*	*	Self–diagnosis
*											Voltage at control unit
*											Sensor
*		*			*	*					Fuel pressure
*		*				*	*				Solenoid–operated injection valves
		*	*								Idle contact
					*						Full–load contact
	*	*	*	*	*	*					Air–flow sensor
	*	*	*								Idle actuator
*	*	*	*								Air–induction system
		*									Idle speed
*		*		*	*						Ignition coil
*		*	*	*	*						Primary signal
		*	*	*	*	*					Secondary pattern
*	*	*	*		*	*		*	*		Ignition point
		*									Exhaust gas
		*									Overrun cut–off
		*	*	*							Interference–suppression resistors
		*	*	*							Noise test
					*						Interference

TROUBLE–SHOOTING CHART (CONTINUED)

Customer complaint (symptoms of trouble)

1. Starting motor operates but engine fails to start or starts only with difficulty.	2. Engine starts but then dies.	3. Rough idling (engine speed, exhaust gas).	4. Poor throttle response, flat spot during acceleration.	5. Engine misfiring. (ignition, injection).	6. Maximum engine power/top speed not reached.	7. Fuel consumption too high.	8. Engine running on (dieseling).	9. Engine pinging/knocking.	10. Engine overheating.	11. Fault lamp.	Cause (component fault)
			*							*	Throttle valve
			*								Fuel delivery
	*	*	*								Air bleed of tank
		*	*								Lambda closed–loop control
*	*	*	*	*	*	*		*	*	*	Control unit

SELF-DIAGNOSIS TEST TABLE

Pocket system tester Fault indication	Fault code	Flashing code	Test instructions/Test conditions	Terminals	Set values
Data exchange not possible			Ignition on: Fault lamp lights up. Prerequisite for fault output: Leads to diagnosis plug/fault lamp and power supply for control unit including term. 18 O.K. Leads and power supply O.K., but no fault output: Control unit defective.	4, 12, 17, 18	———
Lambda sensor Open circuit	13	1 3	Open-circuit in lead to lambda sensor. Sensor defective.	24	———
Engine temp. sensor Short to ground	14	1 4	Test temperature sensor and lead for short-circuit to ground (short to ground).	13	———
Engine temp. sensor Op. circ./sh. to B+	15	1 5	Test temperature sensor and leads for open-circuit (op. circ.) and short-circuit to positive (sh. to B+). Temperature-sensor resistance: at +15...+30°C : at approx. +80°C :	13, ground	 1450...3300 Ω 280....360 Ω
Lambda sensor Short to ground	44	4 4	Test lead for short-circuit to ground (short to ground). Watch out for worn cable insulation! Pronounced leaning, e.g. tank run empty.	24	———
Lambda sensor Short to B+	45	4 5	Test lead for short-circuit to positive (short to B+). Watch out for worn cable insulation! Mixture too rich.	24	———
Battery voltage too low	48	4 8	Supply voltage for control unit too low (with engine running): Test voltage dips at positive and ground terminal. Charge battery. Test alternator system.	35(+), 5(-)	Greater than 10 V
Battery voltage too high	49	4 9	Supply voltage for control unit too high (with engine running): Test alternator regulator.	35(+), 5(-)	Less than 16 V

SELF-DIAGNOSIS TEST TABLE (CONTINUED)

Pocket system tester Fault indication	Fault code	Flashing code	Test instructions/Test conditions	Terminals	Set values
Control unit Digital sec.(comput) defective	51 or 55	5 1 or 5 5	Control unit defective.	———	———
CO potentiometer Signal too low	65	6 5	Measure resistance of CO potentiometer (idle potentiometer): Test lead for short-circuit to ground. Open-circuit at term. 9. Term. 6 and term. 9 jumpered.	30	Measure resistance at air-flow sensor between term. and term. 4: Minimum 0...30 Ω Maximum: The value measured between term. 3 and term. 4 may be up to 30 Ω less. (Set value between term. 3 and term. 4: 300...550 Ω)
CO potentiometer Signal too high	66	6 6	Measure resistance of CO potentiometer (idle potentiometer): Test potentiometer and leads for open-circuit and short-circuit to positive. If there is an open-circuit at term. 6, fault code 7 4 is also displayed.	30	
Idle switch Short to ground	67	6 7	Fault: Idle contact (in throttle-valve switch) permanently closed or short-circuit to ground (short to ground) in lead. Idle contact closed in off position: Actuate throttle valve somewhat:	2, ground	 Approx. 0 Ω Infinity Ω
Air-temp. sensor Short to ground	69	6 9	Test temperature sensor and lead for short-circuit to ground (short to ground).	22	———
Air-temp. sensor Open circuit	71	7 1	Test temperature sensor and leads for open-circuit. Temperature-sensor resistance: at +15°C...+30°C:	22, 6(–)	 1450...3300 Ω
Full-load switch Short to ground	72	7 2	Fault: Full-load contact (in throttle-valve switch) permanently closed. Fault lamp lights up only intermittently during overrun. Full-load contact closed in full-throttle position: Release accelerator pedal somewhat:	3	 0 Ω Infinity Ω

SELF-DIAGNOSIS TEST TABLE (CONTINUED)

Pocket system tester Fault indication	Fault code	Flashing code	Test instructions/Test conditions	Terminals	Set values
Air-flow sensor/ Air-mass sensor Signal too low	73	7 3	Test: Lead to air-flow sensor term. 7 for short-circuit to ground, leads to term. 7 and term. 9 for open-circuit, leads to term. 6 and term. 9 for mutual contact. Air-flow sensor defective.	6(-), 7, 9(+)	———
Air-flow sensor/ Air-mass sensor Signal too high	74	7 4	Test: Lead to air-flow sensor term. 6 for open-circuit (note: fault code 66 also appears), leads to term. 6 and term. 7 for short-circuit to positive (5 V or battery positive). Test resistances of air-flow sensor: between term. 6 and term. 7 (deflect sensor flap): between term. 6 and term. 9: Air-flow sensor defective.	6(-), 7	8...2500 Ω 300...550 Ω
Transmission identification Short to ground	75	7 5	Test lead for short-circuit to ground (short to ground) or switch (if fitted) permanently closed (faulty). Continue test with electronic transmission control.	8	———
No fault stored		1 2	Fault code 1-2 constantly repeated. Continue trouble-shooting with trouble-shooting chart.	—	———

Pressure regulator
* Fuel pressure 2,8...3,2 bar

Electric fuel pump
* Fuel delivery (measured in return line) at least 850 cm ^{3} /30s
Supply voltage (under load): at least 12 V

Temperature sensor (air)
* Internal electrical resistance measured at air-flow sensor between term. 4 and term. 5 at ambient temperature (+15°C...+30°C): 1450...3300 Ω

Temperature sensor (engine), plug color, blue.
* Internal electrical resistance at ambient temperature (+ 15° C...+ 30° C): 1450...3300 Ω
with engine at normal operating temperature (approx. + 80° C): 280....360 Ω

Solenoid-operated injection valve
* Internal electrical resistance at ambient temperature (+ 15° C...+ 30° C): 14,5...17,5 Ω

Air-flow sensor
* Internal electrical resistance between:
term.2 and term.4 : 8...2500 Ω (1)
term.3 and term.4 : 300...550 Ω
term.1 and term.4 (CO potentiometer):
Minimum 0....30 Ω
Maximum: the actual value measured between term.3 and term.4 is permitted to be up to 30 Ω less.

(1) Deflect air-flow sensor flap slowly as far as it will go.
Resistance fluctuates between the terminals of the potentiometer.

Engine-speed sensor and reference-mark sensor
* Internal electrical resistance at ambient temperature (+15°C...+30°C): 400...800 Ω
* Air gap: 0,8 ±0,5 mm

Throttle-valve switch
* Resistance value of idle contact term.2 and term.18): 0 Ω
* Resistance value of full-load contact (term.3 and term.18) 0 Ω

Pressure sensor (altitude sensor)
* Total resistance between term.3(+) and term.2(-) : 2300...2500 Ω
* Resistance between wiper term.1(S) and term.2(-) : 400...2300 Ω
Test specification is altitude-dependent

Idle actuator
* Internal electrical resistance at +15°...+30°C : approx. 8 Ω

Lambda sensor
* Resistance value of heater winding 1...15 Ω

Ignition coil
* Primary resistance approx. 0 Ω
* Secondary resistance 5000...7200 Ω

Interference-suppression resistors
* High-voltage distributor rotor: 1 k Ω
The secondary side of the ignition system must be interference-suppressed with at least 5k Ω total resistance. High-voltage resistance cables are installed as standard.

TEST SPECIFICATIONS (CONTINUED)

Idle test:
Engine at normal
operating temperature,
switch off loads.

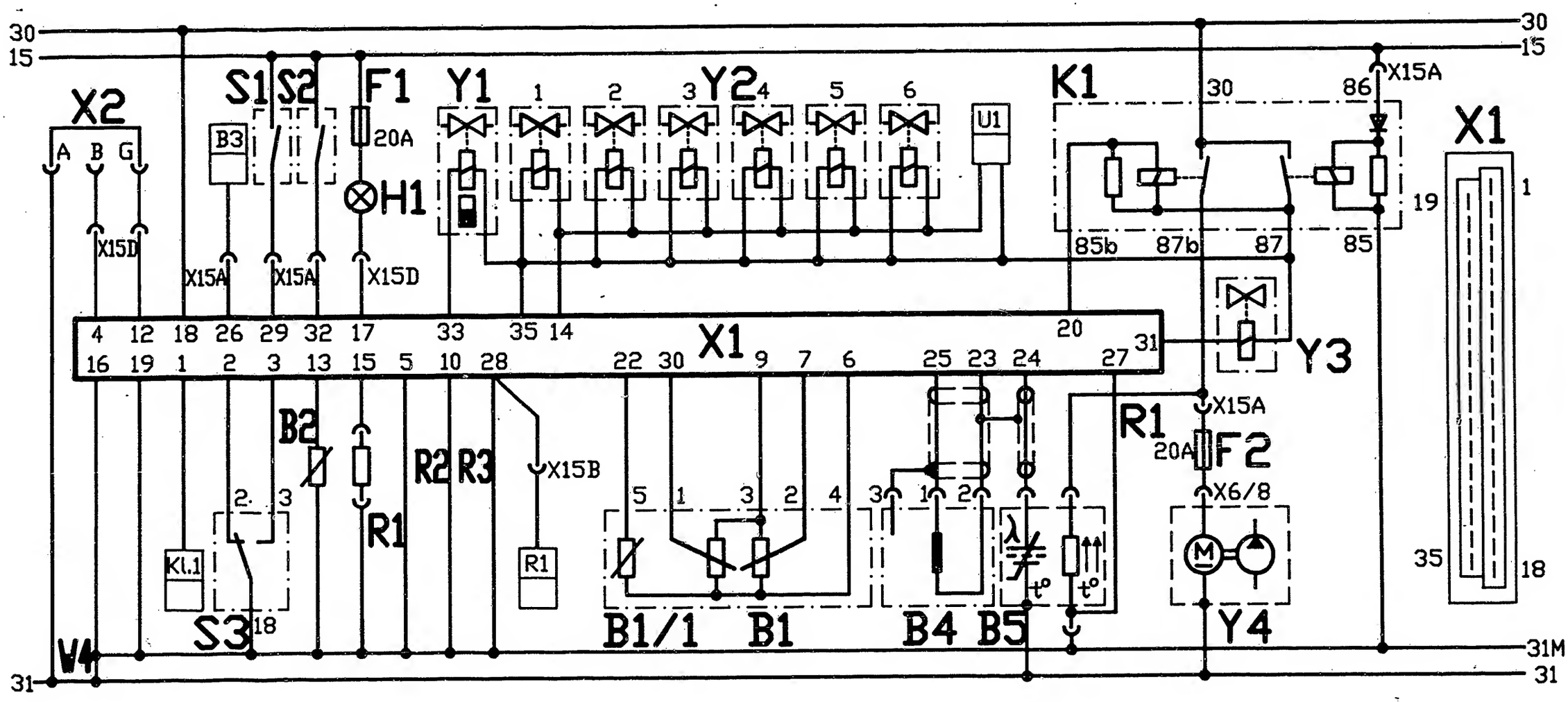
* Idle speed:	600 ±40 min $^{-1}$	+)
* Spark-advance angle:	10 ±5 ° crankshaft	+)

Automatic transmission to N or P

+) Attention! The basic values stated may deviate due to variant encoding. Pay attention to table in "Special Features" section.

See equipment and Autodata microcards for settings for valve clearance and other engine-related data.

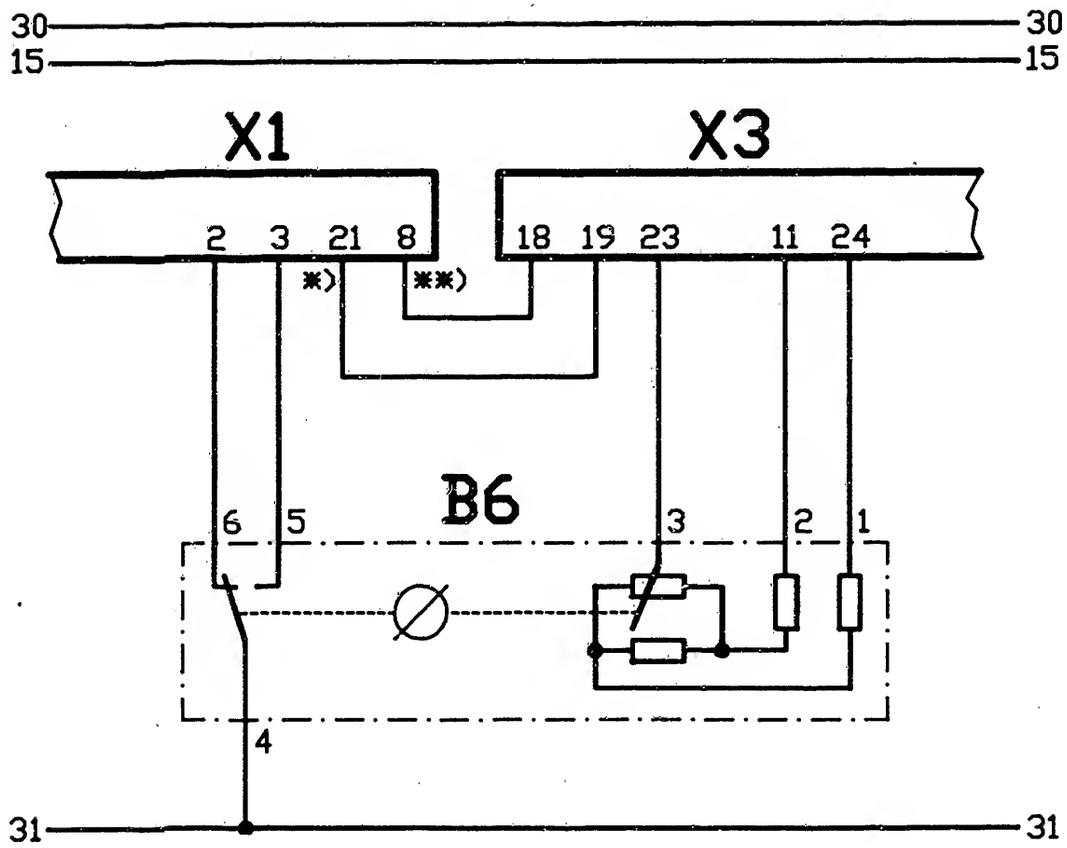
For production reasons:
continued on the following
coordinate.

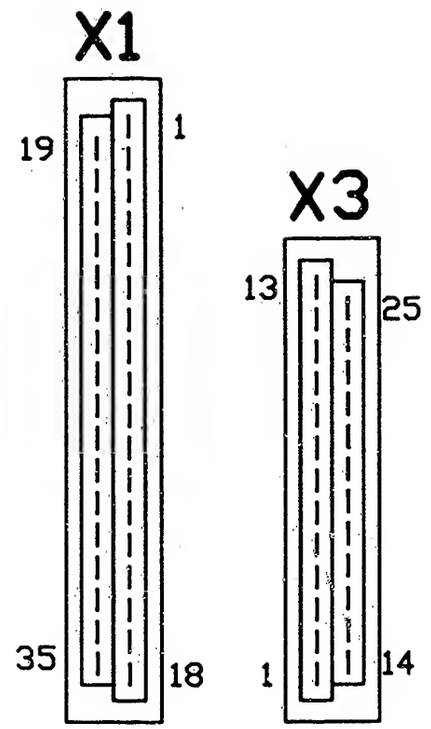


261/721

ELECTRICAL TERMINAL DIAGRAM

B1 = Air-flow sensor
B1/1= Temperature sensor (air)
B2 = Temperature sensor (engine)
B3 = Distance travelled sensor
B4 = Lambda sensor
B5 = Eng.-speed/ref.-mark sensor
F1,F2 = Fuse 20A
H1 = Fault lamp
K1 = Motronic relay
Term. 1 = Ignition coil term. 1
R1 = See variant coding
R2 = For automatic transm. only
R3 = For man. shifted transm. only
S1 = Switch, compressor
S2 = Air conditioner
S3 = Throttle-valve switch
U1 = On board computer
W4 = Ground strap, engine
X1 = Motronic control-unit plug
X2 = Diagnostic plug
Y1 = Injection valve
Y2 = Tank bleeder valve
Y3 = Idle actuator
Y4 = Electric fuel pump



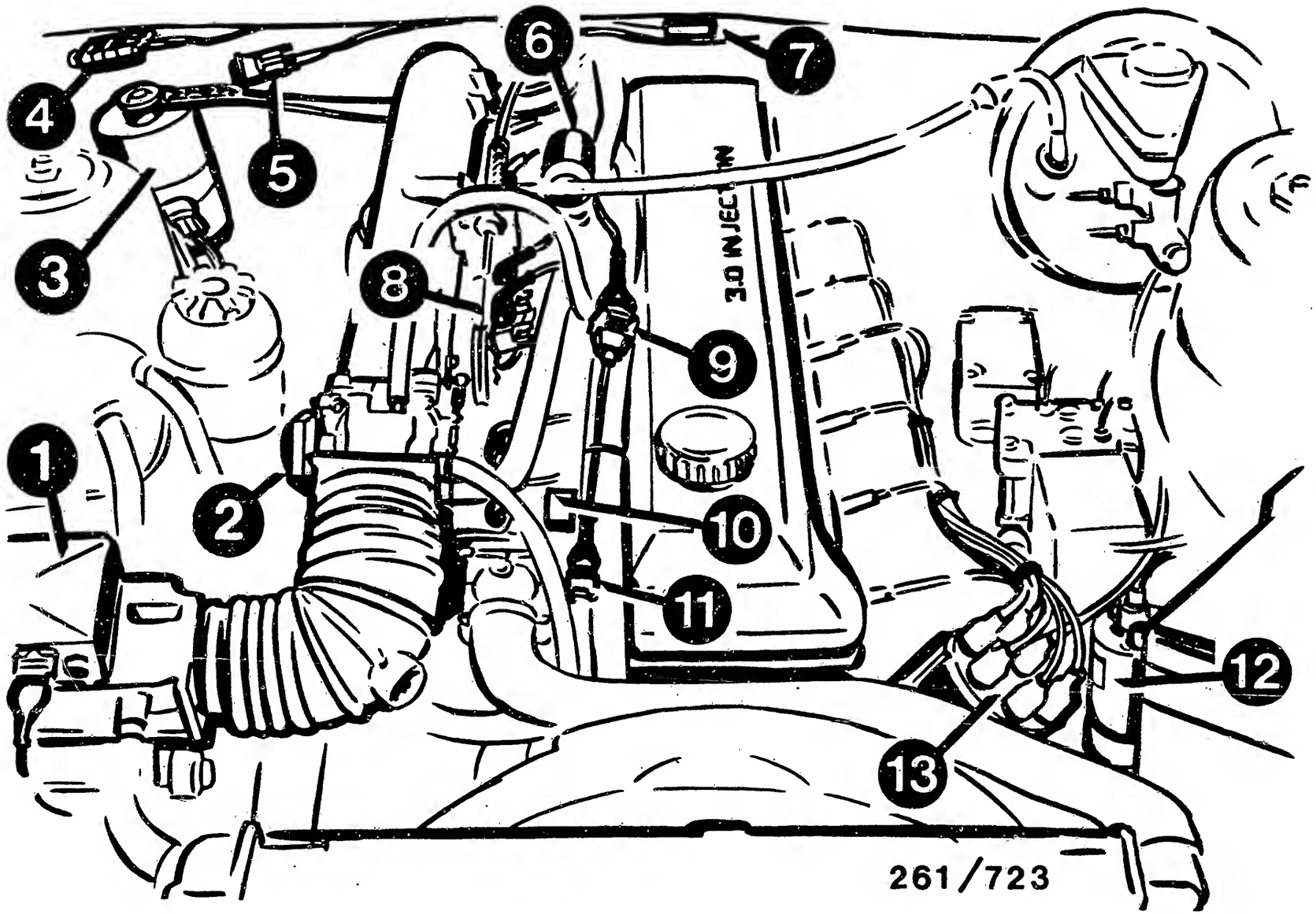


261/722

B6 = Throttle-valve switch with potentiometer for electronic transmission control
X1 = Motronic control-unit plug
X3 = Transmission control-unit plug

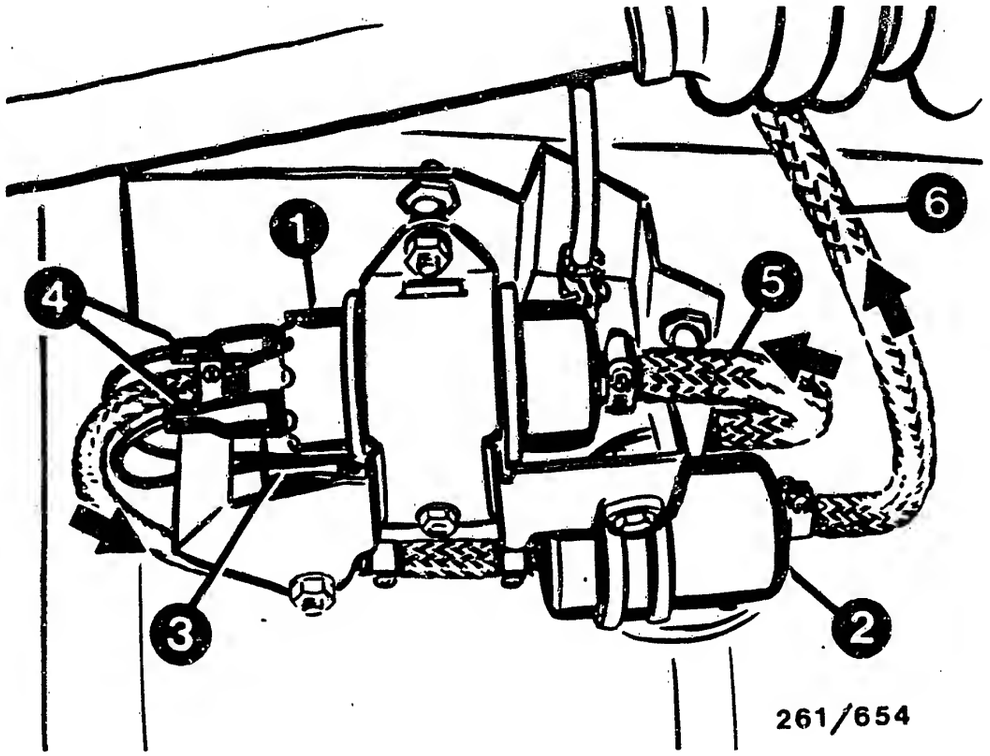
*) = Output for engine speed
**) = Input for engine action

ELECTRICAL TERMINAL DIAGRAM (CONTINUED)
Deviations for vehicles with electronic transmission control



INSTALLATION POSITION OF COMPONENTS

1 = Air-flow sensor
2 = Throttle-valve switch
3 = Activated-carbon canister
4 = Diagnostic plug
5 = Octane-rating encoding plug
6 = Rotary actuator
7 = Lambda-sensor plug-in connection
8 = Injection valves
9 = Engine-speed-sensor plug-in connection
10 = Tank-ventilation valve
11 = Temperature sensor (engine)
12 = Ignition coil
13 = High-voltage distributor



1 = Electric fuel pump
2 = Fuel filter
3 = Pressure damper
4 = Electrical connections

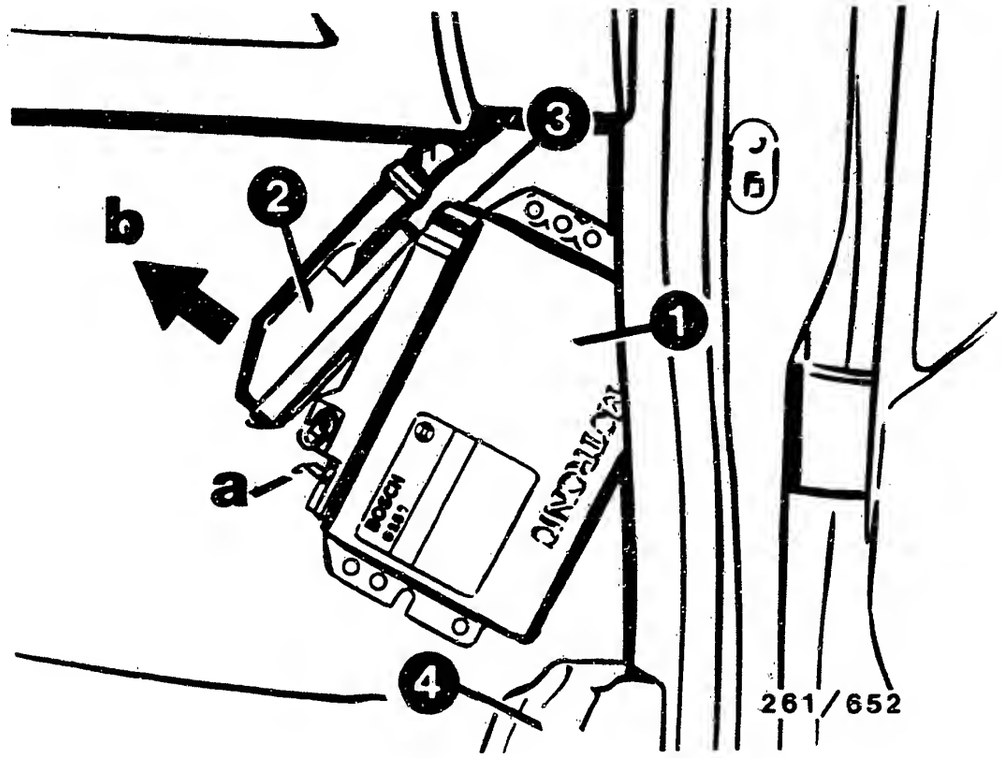
INSTALLATION POSITION OF COMPONENTS (CONTINUED)

* Electric fuel pump and fuel filter:
  in front of the fuel tank.

* Ground terminal:
  In engine compartment at front on left-hand side on the bodywork next to the battery.

* Diagnostic plug:
  In engine compartment on right-hand side on the firewall.

* Octane-rating encoding plug:
  In engine compartment on right-hand side of the firewall.



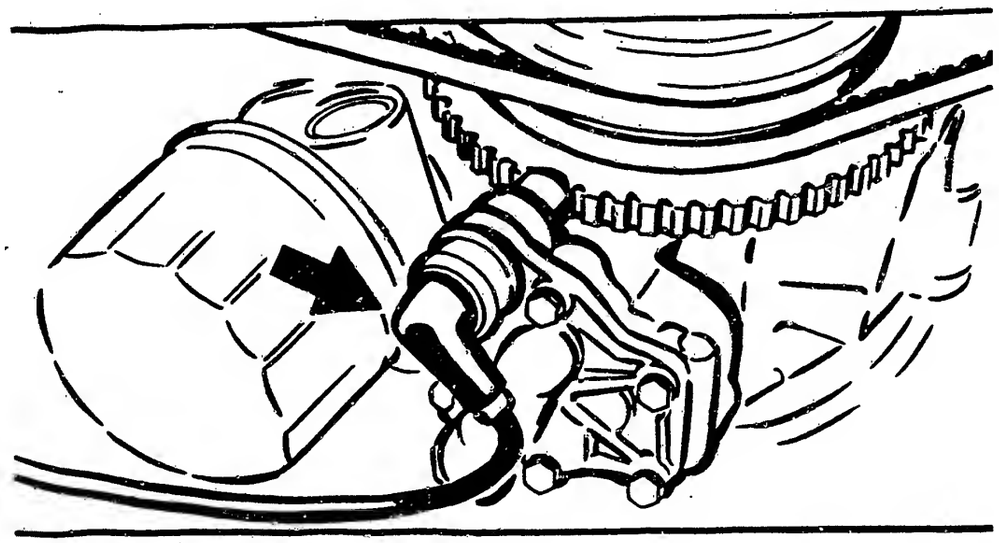
1 = Control unit
2 = Plug
3 = Mechanical encoding with lug
4 = Covering over door sill

INSTALLATION POSITION OF COMPONENTS (CONTINUED)

The indications "right" and "left" always refer to the forward direction of travel.

* Control unit:
  In passenger-side footwell on the right. Slightly lift up rubber strip and cover on door sill. Lift up floor carpet to one side and remove control-unit cover. Unscrew control unit. Unlatch plug (a), fold back (arrow b) and unhook (Item 3).

* Temperature sensor (engine):
  On engine block at the front on the right, blue plug.



261/725

Arrow = Reference-mark / engine-speed sensor

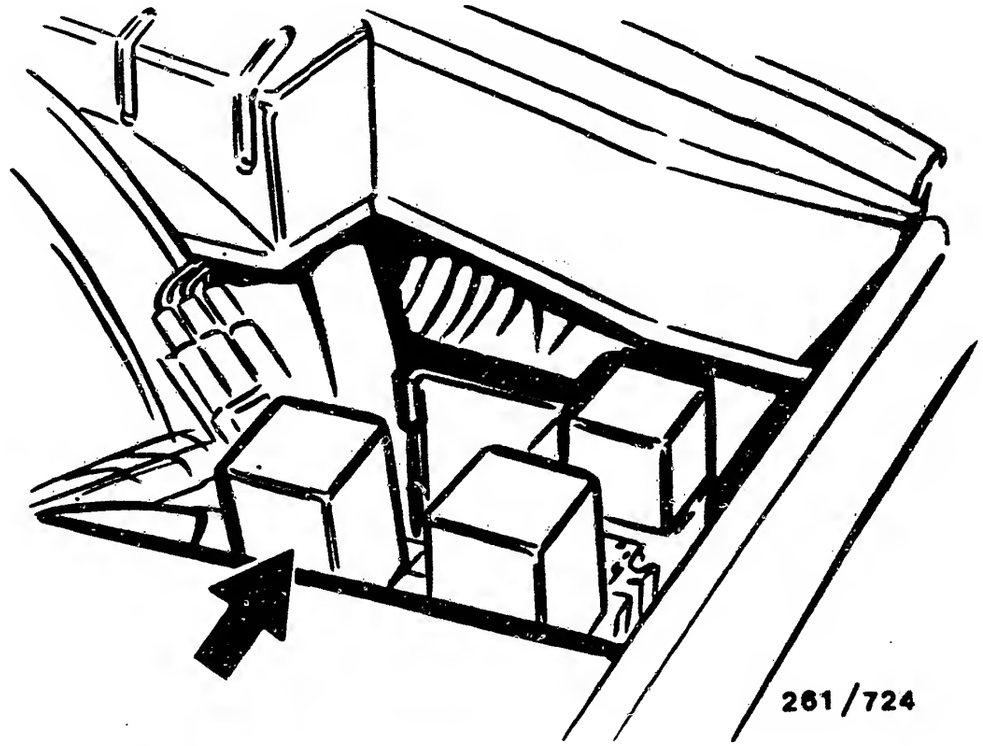
INSTALLATION POSITION OF COMPONENTS (CONTINUED)

* Reference-mark/engine-speed sensor:
  On oil-pump housing next to oil filter
  (accessible from below).

* Lambda sensor:
  In common exhaust pipe upstream of the
  catalytic converters.

* Fuses:
  In instrument panel, bottom left.
  Fuse box can be tilted open at its
  underside.

* Temperature sensor (air):
  In air-flow sensor



261/724

Arrow = Motronic relay

INSTALLATION POSITION OF COMPONENTS (CONTINUED)

* Motronic relay:
  In engine compartment on left-hand side in front of the
  firewall.

* Adjust ignition distributor:
  Remove cap and protective cover from ignition
  distributor.
  Position cylinder 1 to ignition-timing
  mark (pointer in inspection hole on cylinder
  block points to ball in flywheel).
  Center of ignition-distributor rotor must
  point to marking on housing of cylinder 1.
  If necessary, turn ignition-distributor housing;
  to do this, loosen clamping strap.

* Distance-travel frequency sensor:
  At transmission output beneath vehicle.

Trouble-shooting instructions : OPE-5010

BOSCH system : Motronic M 2.5

Make of vehicle : OPEL

Basic microcard : PKW-050

TABLE OF CONTENTS

SPECIAL FEATURES

These trouble-shooting instructions, valid at the time of publication, apply to the following vehicle models:

OPEL Kadett GSi 16V (2.88 ->)
with 2.0 l / 4-cylinder engine,
16 valves,
engine type OHC, 20 XE, C 20 XE

* Motronic M 2.5 with self-diagnosis

* The fault memory can be read out using the Pocket System Tester KTS 300 (0 684 400 300) with the program module PPG 204 as of status 09.01.89.

  Note:
  Further diagnosis possibilities (actuator diagnosis etc), which would be feasible with newer program-module statuses, are not evaluated with these vehicles.

  Pay attention to operating instructions for KTS 300. Connection of the KTS 300 to the diagnosis socket in the vehicle is via the adapter lead 1 684 465 187 (OPEL).

* As an alternative to the KTS 300, the self-diagnosis can be read out by way of a flashing code (not possible with all control units).

* Control unit with 55-pole plug

* Hot-wire air-mass meter with CO potentiometer. Temperature sensor for intake air not required.

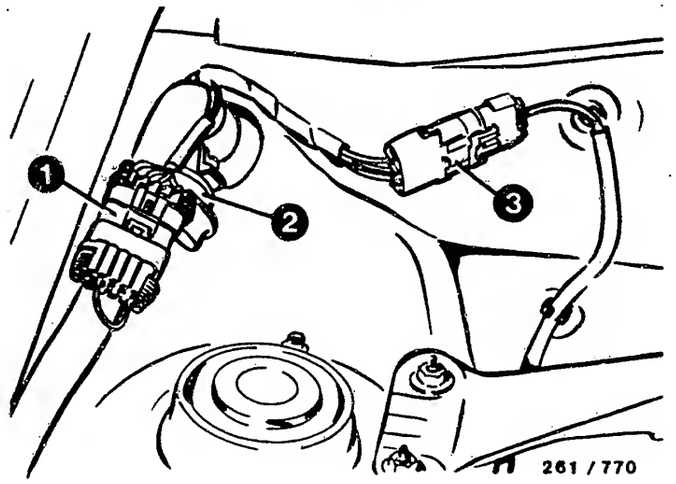
* Knock control integrated into Motronic control unit.

* Variant encoding for adjustment to country versions with and without catalytic converter as well as for influencing engine speed and mixture.

Variant encoding with encoding plug on wiring-harness end.

Engines with catalytic converters, which are designed for 95 RON unleaded, can in an emergency also be operated on 91 RON unleaded.
Engines (without catalytic converter), which are designed for 98 RON, can in an emergency also be run on 95 RON unleaded.

Octane number	Encoding plug with resistance at term. 46 and ground		
	Term. 20 open	Term. 20 connected to ground	Swiss version only with catalytic converter, term. 20 open *)
95 RON with cat.	220 or 470 Ω 1) 750 Ω 2)3) 1200 Ω 3) 2200 Ω 2)	Not permitted	0 Ω 1) 4700 Ω 2)3) Infinity Ω 2)
98 RON without cat.	Not permitted	750 Ω 2)3)4) 1200 Ω 3)4) 2200 Ω 2)	Not permitted



1 = Diagnostic plug
2 = Coding plug (term.46)
3 = Lambda-sensor plug

95 RON = Premium unleaded fuel. 98 RON = Leaded premium fuel
*) If term. 20 is connected to ground there is no injection.

1) Basic value
2) Idle speed is increased by 100 min^{-1} .
3) Acceleration enrichment is enriched.
4) Mixture is enriched: Lambda +4.7% correspond to approx. 1% CO.

* Phase sensor (Hall generator) in ignition distributor for sequential injection, i.e. each injection valve is individually actuated via its own output stage.

* Joint sensor for engine speed and reference mark.

* Single-winding rotary actuator.

* Lambda closed-loop control.

* Tank ventilation system.

* Ignition coil is actuated via external output stage.

Check voltage supply (Motronic relay) to control unit.

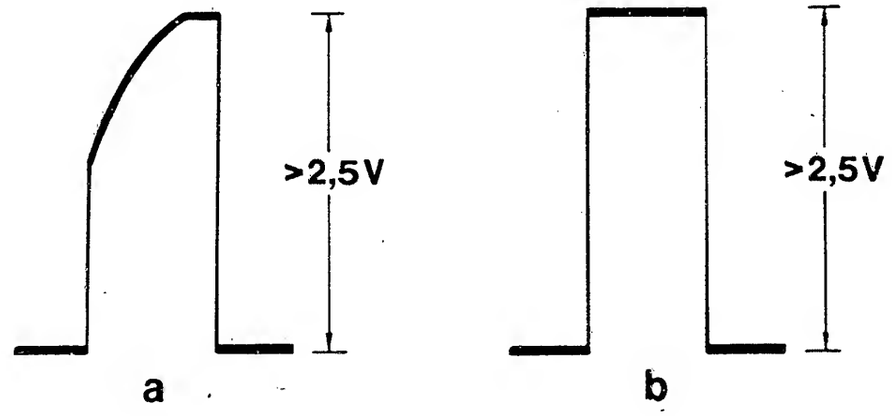
* Switch off ignition.
* Detach control-unit plug.

1. Connect voltmeter to term.18 (+) and term.19 (-).
   * Switch on ignition.
   Set value: battery voltage.
   If set value is not obtained:
   * Check positive lead to B+.
   * Check ground lead and ground terminal.

2. Jumper term.19 and term.36 at connector.
   * Connect voltmeter to term.37 (+) and term.19 (-).
   Set value: battery voltage.
   If set value is not obtained:
   * Check following leads to Motronic relay:
     * From B+ to term.30 and term.86.
     * From control-unit plug term.36 and term. 37 to term.85 and term.87 respectively.

   * Motronic relay defective.

   * If leads, plug connections and relays are OK and the voltage supply still does not function, control unit defective.



261/771

a = Actuating signal with ignition output stage connected.
b = Actuating signal with resistance to ground.

Test ignition output stage.

Perform test if no primary signal is present at ignition coil term.1.

1. Test ignition coil and leads as follows:
   Measure battery voltage and ignition coil term.1 with ignition switched on. If OK, continue test.

2. Test actuating signal of ignition output stage.
   * Control-unit plug and plug on ignition output stage inserted.
   * Push back rubber sleeve on plug of ignition output stage.
   * Connect special input of oscilloscope to term.4 of igntion output stage.
   * Start engine and observe signal.

Test ignition output stage (continued)

Set value: Amplitude of rectangular signal (illustation a) must be greater than 2.5 V
If set value is not obtained:
* Detach plug from ignition output stage. Connect voltmeter to term.3 (+) and term.2 (–). Switch on ignition.
  Set value: battery voltage.
  If set value is not obtained:
  Test leads to driving switch term.15 and to ground. If leads are OK, continue with test.

* At detached plug, connect resistor with 220 Ω at term.4 to ground.
  Start engine and observe signal.
  Set value: amplitude of rectangular signal (illustration b) must be greater than 2.5 V.
  If set value is not obtained:
  Check lead to control unit term.1. If lead is OK, control unit defective.
  If set value is OK: replace ingnition output stage.

Test phase sensor (Hall generator)

* Phase sensor and control unit connected.
* Push back rubber sleeve from sensor plug.

1.Voltage supply.

Connect voltmeter to term.3 (+) and term.1 (–).
Switch on ignition.
Set value: higher than 10 V.

Set value not obtained:
* Detach plug from phase sensor and measure voltage again. Voltage now OK, replace phase sensor.
  If set voltage value is still not obtained, check leads to control unit term.1 and to ground. If leads and plug-in contacts are OK, replace control unit.

2.Phase-sensor signal.

* Connect special input of oscilloscope to sensor plug term.2 (signal) and ground.
  Start engine. Rectangular signal must appear on oscilloscope. (Signal width is dependent on engine speed. Wide signal for low engine speed.)
  If no rectangular signal visible, replace phase sensor.

Testing hot-wire air-mass meter:
Burn-off function.

* Hot wire must be visible.

* Run warmed-up engine for short period at over 2000 min $^{-1}$. Switch off engine. Approx. 4 seconds after engine stops, hot wire glows for approx 1.5 seconds.

Hot wire does not glow:
* Check lead from control unit term.25 to air-mass meter term.4 for open circuit and short circuit to ground.
* Detach connector from air-mass meter and connect voltmeter to connector terminals 4 (+) and 1 (-). Repeat test for burn-off function. Instead of the hot wire glowing, a voltage must be measured.
  Set value: approx. 5 V

* If no voltage is measured, control unit defective.

* If voltage reaches set value, air-mass meter defective.

STRUCTURE AND USAGE

These brief instructions encompass essentially vehicle-specific special features and test specifications (set values).

In accordance with the customer complaint, the trouble-shooting chart leads to different causes/component faults.
For a detailed description of trouble-shooting, see the information in the trouble-shooting chart of the basic instructions.

ATTENTION: Even if reference is made to basic instructions, the set values, terminal assignments and special features of these vehicle-related brief instructions are always binding.

SAFETY AND PRECAUTIONARY MEASURES

In order to keep persons out of danger and to avoid damage to the engine, trigger boxes and control units or to the ignition system, observe the information in the basic instructions.

CAUTION!
High-performance ignition system with dangerous primary and secondary voltages!

Touching voltage-carrying components or terminals may prove fatal (both on the primary and secondary sides).

Avoid fuel injection and high-tension flashover when testing compression!
Motronic relay is therefore to be disconnected.

TROUBLE-SHOOTING CHART

Customer complaint (fault symptoms)

1. Starting motor operates, engine fails to start or starts only with difficulty.	2. Engine starts but then dies.	3. Idle problems (engine speed, exhaust gas).	4. Poor throttle take-up, flat spot during acceleration.	5. Engine missing (ignition, injection).	6. Maximum engine power/top speed not reached.	7. Fuel consumption too high.	8. Engine running on (dieseling).	9. Engine pinging/knocking.	10. Engine overheating.	11. Fault lamp.	Cause (component fault)
*	*	*	*	*	*	*	*	*	*	*	Self-diagnosis
*											Voltage supply, relay
*											Pick-up
*	*	*				*					Temperature sensor, engine
*		*			*	*					Fuel pressure
*		*				*	*				Solenoid-operated injection valves
		*	*								Idle contact
					*						Full-load contact
	*	*	*	*	*	*					Air-mass meter
	*	*	*								Idle actuator
*	*	*	*								Air intake system
		*									Idle speed
*		*		*	*						Ignition coil
*				*							Ignition output stage
*		*	*	*	*						Primary signal
		*	*	*	*	*					Secondary pattern
*	*	*	*		*	*		*	*		Ignition point
		*									Exhaust gas
		*									Overrun cutoff
		*	*	*							Interference-suppression resistors
					*						Interference

TROUBLE-SHOOTING CHART (CONTINUED)

Customer complaint (Fault symptoms)

1. Starting motor operates, engine fails to start or starts only with difficulty.	2. Engine starts but then dies.	3. Idle problems (engine speed, exhaust gas).	4. Poor throttle take-up, flat spot during acceleration.	5. Engine missing (ignition, injection).	6. Maximum engine power/top speed not reached.	7. Fuel consumption too high.	8. Engine running on (dieseling).	9. Engine pinging/knocking.	10. Engine overheating.	11. Fault lamp.	Cause (component fault)
				*							Throttle valve
				*							Fuel delivery quantity
	*	*	*								Tank ventilation
				*			*	*			Knock sensor
	*	*	*		*						Phase sensor
	*		*	*							Variant coding
			*	*							Lambda closed-loop control
	*	*	*	*	*	*		*	*	*	Control unit

SELF-DIAGNOSIS TEST TABLE

Pocket system tester Fault indication	Fault code	Flashing code	Test instructions/Test conditions	Terminals	Set values
No exchange of data			Ignition on: Fault lamp lights up. Prerequisite for fault output: Leads to diagnosis plug/fault lamp and power supply to control unit including term. 15 O.K. Leads and power supply O.K., however no fault output: Control unit defective.	13, 18, 22	———
Lambda sensor Open-circuit	13	1 3	Test leads to lambda sensor for open-circuit.	10(-), 28	———
Temperature sensor Engine Short-circuit to ground	14 1)	1 4 1)	Test temperature sensor and lead for short-circuit to ground.	45	———
Temperature sensor Engine Open-circuit/short-circuit to positive	15 1)	1 5 1)	Test temperature sensor and leads for open-circuit and short-circuit to positive. Temperature-sensor resistance: at +15...+30°C : at approx. +80°C :	45, ground	 1450...3300 Ω 280....360 Ω
Knock sensor 1 Incorrect/no signal	16	1 6	Test knock-sensor leads for open-circuit and short-circuit to ground as well as plugs for corrosion and proper contact. Test knock-sensor tightening torque:	11, 30	 15...25 Nm
Control unit Knock-control module defective	18	1 8	If knock sensor, leads and plug connections O.K., replace Motronic control unit.	11, 30	
Injection valve Short-circuit to positive Cylinder 1 Cylinder 2 Cylinder 3 Cylinder 4	 25 26 27 28	 2 5 2 6 2 7 2 8	Test leads for short-circuit to positive. Watch out for worn cable insulation! Fault code/flashing code 25 applies to injection valve cyl. 1 (term. 17), 26 applies to cyl. 2 (term. 16), 27 applies to cyl. 3 (term. 35) and 28 applies to cyl. 4 (term. 34). Resistance of injection valve:	 17 16 35 34	 14.5...17 Ω

1) Not used at present.

SELF-DIAGNOSIS TEST TABLE (CONTINUED)

Pocket system tester. Fault indication	Fault code	Flashing code	Test instructions/Test conditions	Terminals	Set values
Lambda sensor Short-circuit to ground	44	4 4	Test lead for short-circuit to ground. Watch out for worn cable insulation! Pronounced leaning, e.g. tank run empty.	28	———
Lambda sensor Short-circuit to positive	45	4 5	Test lead for short-circuit to positive. Watch out for worn cable insulation! Mixture too rich.	28	———
Battery voltage too low	48	4 8	Supply voltage for control unit too low (with engine running): Test voltage dips at positive and ground terminal. Charge battery. Test alternator system.	37(+), 19(-)	Greater than 10 V
Battery voltage too high	49	4 9	Supply voltage for control unit too high (with engine running): Test alternator regulator.	37(+), 19(-)	Less than 16 V
Control unit Digital section (computer) defective	51 or 55	5 1 or 5 5	Control unit defective.	—	—
CO potentiometer signal too low	65 2)	6 5 2)	Potentiometer must not be on left stop. Measure resistance and voltage at potentiometer. Test lead for short-circuit to ground.	43	Measure at air-mass meter between term. 2 and term. 6. Resistance: Minimum: 0...30 Ω Maximum: 900...1100 Ω Voltage (plug connected, ignition on): 0.25...4.8 V. Basic setting: 2.5 V
CO potentiometer signal too high	66 2)	6 6 2)	Measure resistance and voltage at potentiometer. Test leads for open-circuit and short-circuit to positive.	43	
Idle switch Short-circuit to ground	67	6 7	Fault: Idle contact (in throttle-valve switch) permanently closed or short-circuit to ground in lead. Idle contact closed in off position: Actuate throttle valve somewhat:	52, ground	Approx. 0 Ω Infinity Ω

2) Applies only to vehicles without catalytic converter.

Pocket system tester Fault indication	Fault code	Flashing code	Test instructions/Test conditions	Terminals	Set values
Full-load switch Short-circuit to ground	72	7 2	Fault: Full-load contact (in throttle-valve switch) permanently closed. Fault lamp only lights up intermittently during overrun. Full-load contact closed in full-throttle position: Release accelerator pedal somewhat:	53	 0 Ω Infinity Ω
Air-flow sensor/ air-mass meter Signal too low	73	7 3	Test: Leads to air-mass meter term. 3 (signal) and term. 5 (battery voltage) for open-circuit and lead to term. 3 for short-circuit to ground. Test resistances of air-mass meter: between term. 1 and term. 2 (ground terminals): between term. 2 and term. 3 (precision resistor): Air-mass meter defective.	7	——— 0 Ω 2,5...3,1 Ω
Air-flow sensor/ air-mass meter Signal too high	74	7 4	Test: Lead to air-mass meter term. 3 for short-circuit to positive as well as both ground leads (term. 1 and term. 2) for open-circuit. Test resistances of air-mass meter: between term. 1 and term. 2 (ground terminals): between term. 2 and term. 3 (precision resistor): Air-mass meter defective.	7, 26(-), 2.grnd.	 0 Ω 2,5...3,1 Ω
Transmission ident. Short-circuit to ground	75	7 5	Test lead for short-circuit to ground or switch (if fitted) permanently closed (fault). Continue testing with electronic transmission control.	51	———
Injection valve Open-circuit/short-circuit to ground Cylinder 1 Cylinder 2 Cylinder 3 Cylinder 4	 81 82 83 84	 8 1 8 2 8 3 8 4	Test leads for short-circuit to ground and open-circuit. Fault code/flashing code 81 applies to injection valve cyl. 1 (term. 17), 82 applies to cyl. 2 (term. 16), 83 applies to cyl. 3 (term. 35) and 84 applies to cyl. 4 (term. 34). Open-circuit in positive lead to relay term. 87. Resistance of injection valve:	 17 16 35 34	 14.5...17 Ω
No fault stored		1 2	Flashing code 1-2 constantly repeated. Continue trouble-shooting with trouble-shooting chart.	—	———

Pressure regulator
* Fuel pressure 2,3...2,7 bar

Electric fuel pump
* Fuel delivery (measured in return) min. 850 cm ^{3} /30s
Supply voltage (under load): min. 12 V

Temperature sensor (engine), Plug color blue.
* Electrical internal resistance at ambient temperature (+ 15° C...+ 30° C): 1450...3300 Ω
engine at operating temperature (approx. + 80° C): 280... 360 Ω

Solenoid-operated injection valve
* Electrical internal resistance at ambient temperature (+ 15° C...+ 30° C): 14,5... 17 Ω

Hot-wire air-mass meter
* Resistance value between term.1 and term.2 (ground terminals): 0 Ω
term.2 and term.3 (measurement resistance): 2,5...3,1 Ω
term.2 and term.6 (CO potentiometer): 0....1100 Ω

Engine-speed sensor and reference-mark sensor
* Electrical internal resistance at ambient temperatur (+15°C...+30°C): 400...800 Ω
* Air gap: 0,8 ±0,5 mm

Throttle-valve switch
* Resistance value of idle contact (term.18 and term.2): approx. 0 Ω
* Resistance value of full-load contact (term.18 and term.3) approx. 0 Ω

Interference-suppression resistors (high-voltage side)
* High-voltage-distributor rotor: 1 k Ω
* Plug on high-voltage-distributor dome and on ignition coil each 1 k Ω
* Spark-plug connector each 1 k Ω

Knock sensor
* Tightening torque 15...25 Nm
Fit knock sensor <u>without</u> tooth lock washer and spring lock washer.

Idle actuator
* Electrical internal resistance at +15°...+30°C : approx. 8 Ω

Lambda sensor
* Resistence value of heating coil 1..15 Ω

Tank-ventilation valve (not from Bosch)
* Electrical internal resistance at +15°C...30°C : approx. 28 Ω

Ignition coil
* Primary resistance 0,6....1,0 Ω
* Secondary resistance 6400...11100 Ω

TEST SPECIFICATIONS (CONTINUED)

Idle test:
Engine at operating temperature,
switch off loads.

* Idle speed: 940 ± 50 min $^{-1}$ +)
* Spark-advance angle: 20 ° crankshaft

CO content:

* Without catalytic converter: 0,7...1,2 % by vol. CO +)
adjust mixture at
CO potentiometer in air-
mass meter:
Turning counter-clockwise produces leaner mixture,
turning clockwise produces richer mixture.

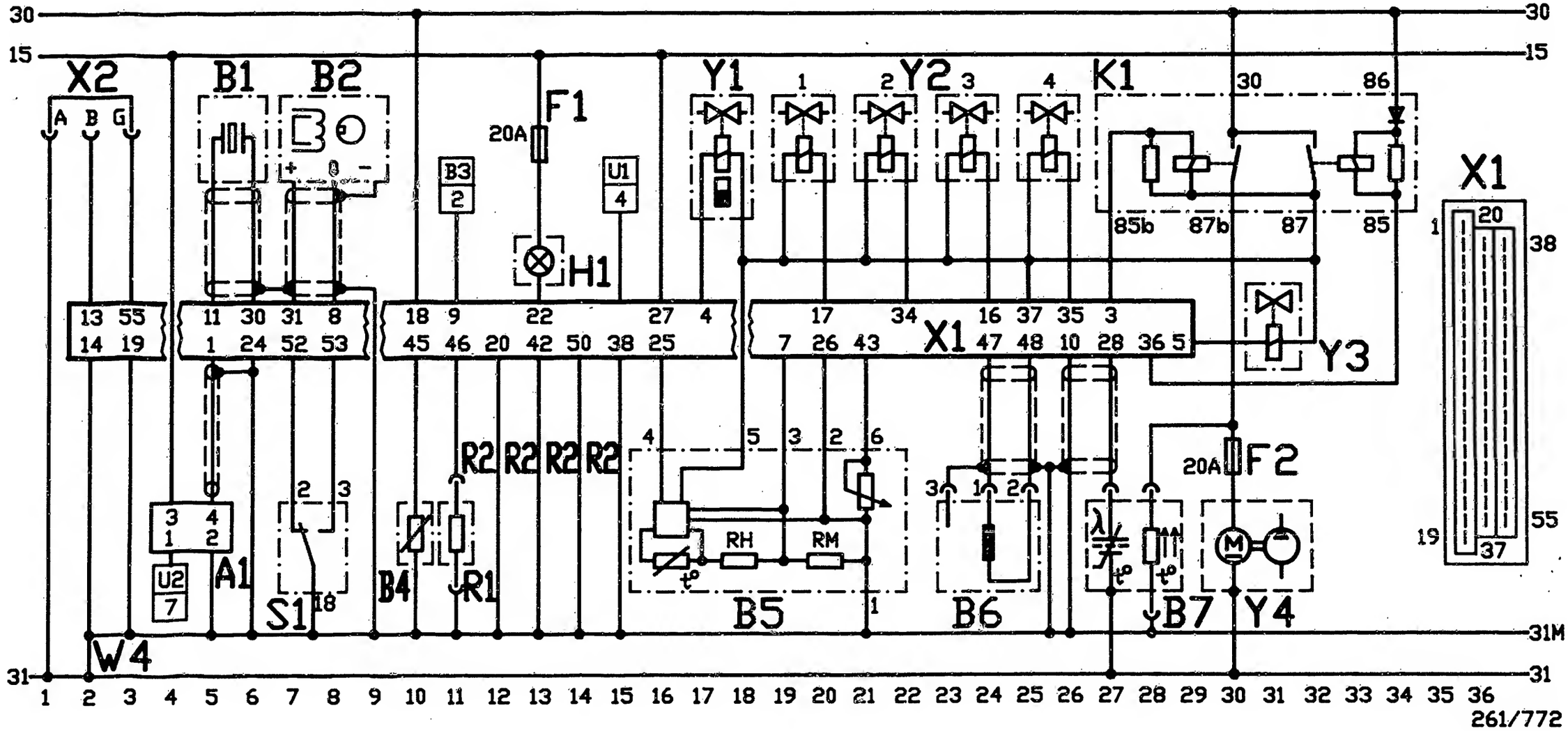
The duration of injection can be
adjusted by max. 0.5 ms with
the potentiometer.

* Vehicles with catalytic converter:
No provision for measurement.
CO potentiometer without effect.

+) Caution! The basic values given may differ due to variant coding. Refer to table in "special features" section.

For settings for valve clearance and other technical engine data, refer to equipment and autodata microcard.

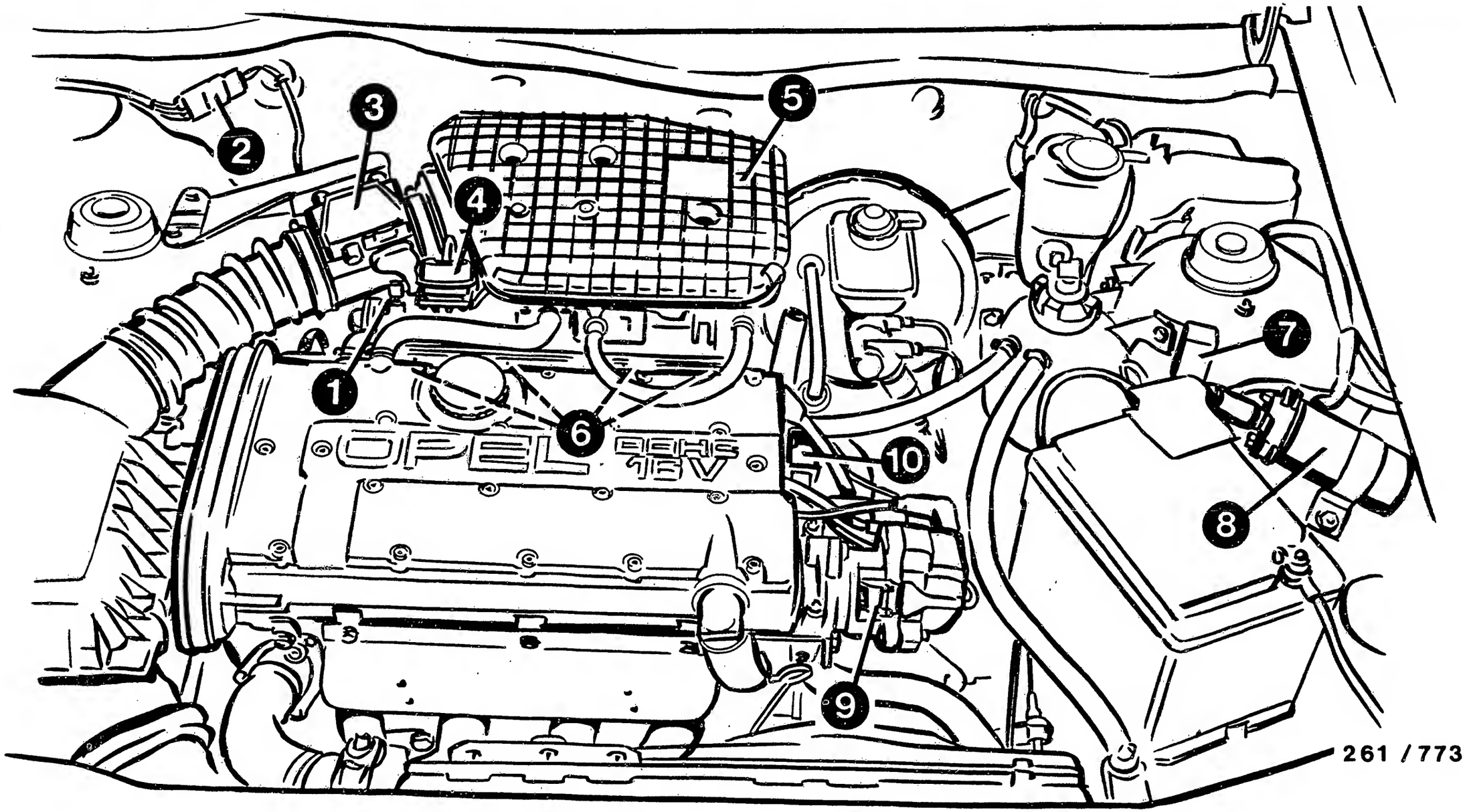
For production reasons:
continued on the following
coordinate.



ELECTRICAL TERMINAL DIAGRAM

A1 = Ignition output stage
B1 = Knock sensor
B2 = Phase sensor
B3 = Distance-traveled frequency sensor
B4 = Temperature sensor (engine)
B5 = Air-mass meter
B6 = Engine-speed/reference-mark sensor
B7 = Lambda sensor
F1/F2 = Fuses
H1 = Fault lamp
K1 = Motronic relay
R1 = See variant coding
R2 = Coding leads for various functions
S1 = Throttle-valve switch
U1 = Vehicle computer
U2 = Tachometer
W4 = Ground strap, engine
X1 = Motronic control-unit plug
X2 = Diagnostic plug
Y1 = Idle actuator
Y2 = Injection valves
Y3 = Tank ventilation valve
Y4 = Electric fuel pump

E23 ⟹
E24 ⟸



INSTALLATION POSITION OF COMPONENTS

1 = Ventilation valve
2 = Lambda-sensor plug
3 = Air-mass meter
4 = Pressure regulator
5 = Air scoop
6 = Injection valves
7 = Motronic relay
8 = Ignition coil with ignition output stage
9 = Ignition distributor with phase sensor (Hall generator)
10 = Tank-ventilation valve

INSTALLATION POSITION OF COMPONENTS (CONTINUED)

The details of installation positions always refer to the forward direction of travel.

* Control unit:
  In the passenger's footwell on the right. Lift up rubber strip and cover on door sill slightly. Fold away carpet to the side and remove control-unit cover. Unscrew control unit. Unlatch plug, fold up and detach.

* Temperature sensor (engine):
  In engine block, on the right at the front in the coolant circuit.

* Reference-mark/engine-speed sensor:
  On engine block at the front on the right, beneath the fastening flange.

* Lambda sensor (heated):
  In the common exhaust pipe upstream of the catalytic converter at the level of the firewall. Plug connection: in engine compartment on the firewall on the right.

* Fuses:
  In the instrument panel, bottom left.

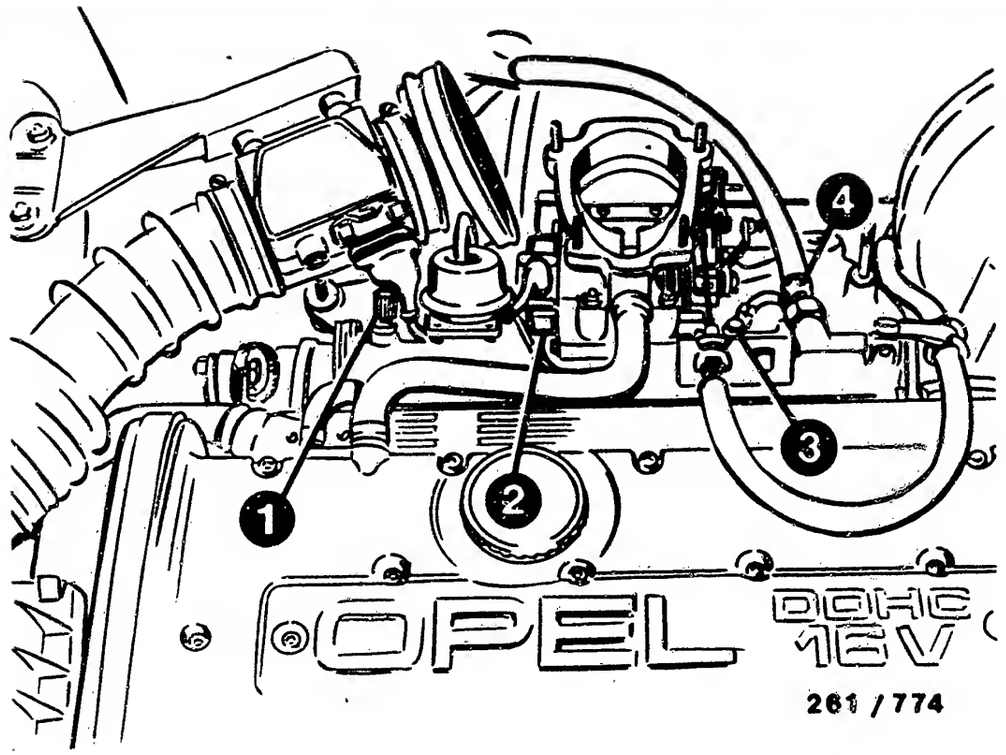
* Idle actuator:
  Beneath intake manifold.

* Knock sensor:
  On engine block beneath intake manifold, in front of idle actuator.

* Electric fuel pump and fuel filter:
  Between fuel tank and right-hand rear wheel.

* Tank ventilation valve:
  On engine block on the left.

* Carbon filter:
  In wheel house of left-hand front wheel.



261 / 774

1 = Ventilation valve
2 = Throttle-valve switch
3 = Ground terminals
4 = High-pressure fuel line

INSTALLATION POSITION OF COMPONENTS (CONTINUED)

* Installation of pressure gauge:
  Remove air scoop. Relieve fuel pressure via ventilation valve. Soak up fuel with cloth. Fit pressure gauge in high-pressure delivery line (M 16x1.5) (Item 4).
  Actuate ventilation valve before and after intervention in the fuel system. Pay attention to leakages!

* Diagnostic plug, coding plug:
  In engine compartment on the right near spring-strut housing.

* Ignition distributor:
  When replacing, plug hole to cam shaft or oil will escape. Check O-ring seal on ignition-distributor shaft.

Trouble-shooting instructions : OPE-5011

BOSCH system : Motronic ML 4.1

Make of vehicle : OPEL

Basic microcard : PKW-050

TABLE OF CONTENTS

SPECIAL FEATURES

These trouble-shooting instructions, valid at the time of publication, apply to the following vehicle models:

OPEL Omega 3000 (3.87 -> 1.88) and

OPEL Senator B (9.87 -> 1.88)

with 3.0 l / 6-cylinder engine, engine type CIH, C 30 LE with catalytic converter, 115 kW.

* Motronic ML 4.1 with self-diagnosis

* The fault memory can be read out using the Pocket System Tester KTS 300 (0 684 400 300) with the program module PPG 204 as of status 09.01.89.

  Note:
  Further diagnosis possibilities (actuator diagnosis etc), which would be feasible with newer program-module statuses, are not evaluated with these vehicles.

  Pay attention to operating instructions for KTS 300. Connection of the KTS 300 to the diagnosis socket in the vehicle is via the adapter lead 1 684 465 187 (OPEL).

* As an alternative to the KTS 300, the self-diagnosis can be read out by way of a flashing code (not possible with all control units).

* Joint sensor for engine speed and reference mark

* Single-winding rotary actuator

* Lambda closed-loop control

* Variant encoding for octane-number adjustment and transmission

* Variant encoding

Octane-number adjustment with encoding plug. (Black plug).

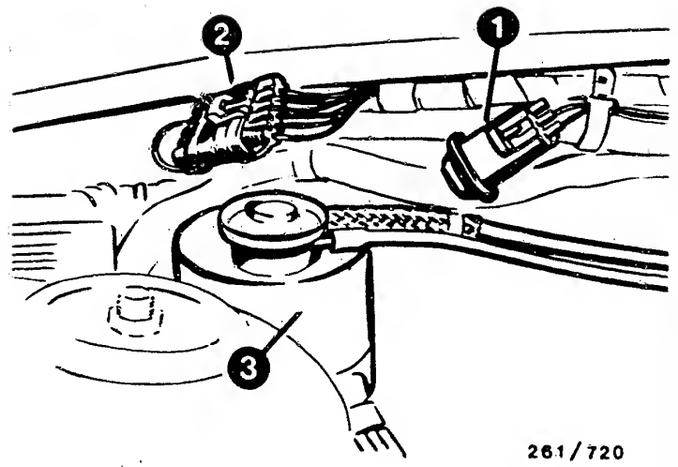
Octane number	Resistance at term. 15 for 3 l engine, 115 kW with regulated catalytic converter
91 RON *)	0 Ω 1) Infinity Ω 2) 750 Ω 2)3)4)
95 RON	220 Ω 1) 1200 Ω 3) 2200 Ω 2) 4700 Ω 2)3)

*) 91 RON = Regular unleaded fuel
(only to be used in an emergency if 95 RON not available).
95 RON = Unleaded premium fuel

1) = Basic value
2) = Idle speed is increased by 100 min $^{-1}$.
3) = Idle enrichment is enriched.
4) = Advance is -5.25 °CS (retard direction) over entire map range.

* Vehicles with electronic transmission control:
When shifting gear, the electronic transmission control produces a brief ignition-timing adjustment via the Motronic control unit. The jerk when changing gear is thus reduced.

* Ignition distributor is used only as high-tension distributor.
Adjustment required.



1 = Octane-rating encoding plug
2 = Diagnostic plug
3 = Activated-carbon canister

Vehicles with catalytic converter: term. 27 infinity Ω (open)

Vehicles with manually shifted transmission:
term. 10 infinity Ω (open)
term. 28 zero Ω (to ground)

Vehicles with automatic transmission:
term. 10 zero Ω (to ground)
term. 28 to selection-lever position P and N: zero Ω (via selection lever to ground). In this way, the idle speed is reduced in order to avoid driving off. In all other selection-lever positions, term. 28 is open (0 Ω)

Vehicles with air conditioner:
term. 29 to switch for defroster lever (air-conditioner readiness).
term. 32 to switch for compressor.

Vehicles with distance-travelled frequency sensor (speedo signal):
term. 26 connected to distance-travelled frequency sensor.
Distance-travelled freqency sensor is installed only in conjunction with the on-board computer, LCD instrument or electronic speedometer.

STRUCTURE AND USAGE

These brief instructions encompass essentially vehicle-specific special features and test specifications (set values).

In accordance with the customer complaint, the trouble-shooting chart leads to different causes/component faults.
For a detailed description of trouble-shooting, see the information in the trouble-shooting chart of the basic instructions.

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SAFETY AND PRECAUTIONARY MEASURES

In order to keep persons out of danger and to avoid damage to the engine, trigger boxes and control units or to the ignition system, observe the information in the basic instructions.

CAUTION!
High-performance ignition system with dangerous primary and secondary voltages!

Touching voltage-carrying components or terminals may prove fatal (both on the primary and secondary sides).

Avoid fuel injection and high-tension flashover when testing compression!
Motronic relay is therefore to be disconnected.

TROUBLE-SHOOTING CHART

Customer complaint (symptoms of trouble)

1. Starting motor operates, but engine fails to start or starts only with difficulty.	2. Engine starts but then dies.	3. Rough idling (engine speed, exhaust gas).	4. Poor throttle response, flat spot during acceleration.	5. Engine misfiring (ignition, injection).	6. Maximum engine power/top speed not reached.	7. Fuel consumption too high.	8. Engine running on (dieseling).	9. Engine pinging/knocking.	10. Engine overheating.	11. Fault lamp.	Cause (component fault)
*	*	*	*	*	*	*	*	*	*	*	Self-diagnosis
*											Voltage at control unit
*											Sensor
*		*			*	*					Fuel pressure
*		*				*	*				Solenoid-operated injection valves
		*	*								Idle contact
					*						Full-load contact
	*	*	*	*	*	*					Air-flow sensor
	*	*	*								Idle actuator
*	*	*	*								Air-induction system
		*									Idle speed
*		*		*	*						Ignition coil
*		*	*	*	*						Primary signal
		*	*	*	*	*					Secondary pattern
*	*	*	*		*	*		*	*		Ignition point
		*									Exhaust gas
		*									Overrun cut-off
		*	*	*							Interference-suppression resistors
		*	*	*							Noise test
					*						Interference

TROUBLE-SHOOTING CHART (CONTINUED)

Customer complaint (symptoms of trouble)

1. Starting motor operates, but engine fails to start or starts only with difficulty.	2. Engine starts but then dies.	3. Rough idling (engine speed, exhaust gas).	4. Poor throttle response, flat spot during acceleration.	5. Engine misfiring (ignition, fuel injection).	6. Maximum engine power/top speed not reached.	7. Fuel consumption too high.	8. Engine running on (dieseling).	9. Engine pinging/knocking.	10. Engine overheating.	11. Fault lamp.	Cause (component fault)
		*		*							Throttle valve
				*							Fuel delivery
	*	*	*								Tank vent
		≑	≑								Lambda closed-loop control
*	*	*	*	*	*	*		*	*	*	Motronic control unit
			*	*							Electronic transmission control

SELF-DIAGNOSIS TEST TABLE

Pocket system tester Fault indication	Fault code	Flashing code	Test instructions/Test conditions	Terminals	Set values
Data exchange not possible			Ignition on: Fault lamp lights up. Prerequisite for fault output: Leads to diagnosis plug/fault lamp and power supply for control unit including term. 18 O.K. Leads and power supply O.K., but no fault output: Control unit defective.	4, 12, 17, 18	———
Lambda sensor Open circuit	13	1 3	Open-circuit in lead to lambda sensor. Sensor defective.	24	———
Engine temp. sensor Short to ground	14	1 4	Test temperature sensor and lead for short-circuit to ground (short to ground).	13	———
Engine temp. sensor Op. circ./sh. to B+	15	1 5	Test temperature sensor and leads for open-circuit (op. circ.) and short-circuit to positive (sh. to B+). Temperature-sensor resistance: at +15...+30°C : at approx. +80°C :	13, ground	 1450...3300 Ω 280....360 Ω
Lambda sensor Short to ground	44	4 4	Test lead for short-circuit to ground (short to ground). Watch out for worn cable insulation! Pronounced leaning, e.g. tank run empty.	24	———
Lambda sensor Short to B+	45	4 5	Test lead for short-circuit to positive (short to B+). Watch out for worn cable insulation! Mixture too rich.	24	———
Battery voltage too low	48	4 8	Supply voltage for control unit too low (with engine running): Test voltage dips at positive and ground terminal. Charge battery. Test alternator system.	35(+), 5(-)	Greater than 10 V
Battery voltage too high	49	4 9	Supply voltage for control unit too high (with engine running): Test alternator regulator.	35(+), 5(-)	Less than 16 V

SELF-DIAGNOSIS TEST TABLE (CONTINUED)

Pocket system tester Fault indication	Fault code	Flashing code	Test instructions/Test conditions	Terminals	Set values
Control unit Digital sec.(comput) defective	51 or 55	5 1 or 5 5	Control unit defective.	——	——
CO potentiometer Signal too low	65	6 5	Measure resistance of CO potentiometer (idle potentiometer): Test lead for short-circuit to ground. Open-circuit at term. 9. Term. 6 and term. 9 jumpered.	30	Measure resistance at air-flow sensor between term. and term. 4: Minimum 0...30 Ω Maximum: The value measured between term. 3 and term. 4 may be up to 30 Ω less. (Set value between term. 3 and term. 4: 300...550 Ω)
CO potentiometer Signal too high	66	6 6	Measure resistance of CO potentiometer (idle potentiometer): Test potentiometer and leads for open-circuit and short-circuit to positive. If there is an open-circuit at term. 6, fault code 7 4 is also displayed.	30	
Idle switch Short to ground	67	6 7	Fault: Idle contact (in throttle-valve switch) permanently closed or short-circuit to ground (short to ground) in lead. Idle contact closed in off position: Actuate throttle valve somewhat:	2, ground	 Approx. 0 Ω Infinity Ω
Air-temp. sensor Short to ground	69	6 9	Test temperature sensor and lead for short-circuit to ground (short to ground).	22	——
Air-temp. sensor Open circuit	71	7 1	Test temperature sensor and leads for open-circuit. Temperature-sensor resistance: at +15°C...+30°C:	22, 6(-)	 1450...3300 Ω
Full-load switch Short to ground	72	7 2	Fault: Full-load contact (in throttle-valve switch) permanently closed. Fault lamp lights up only intermittently during overrun. Full-load contact closed in full-throttle position: Release accelerator pedal somewhat:	3	 0 Ω Infinity Ω

SELF-DIAGNOSIS TEST TABLE (CONTINUED)

Pocket system tester Fault indication	Fault code	Flashing code	Test instructions/Test conditions	Terminals	Set values
Air-flow sensor/ Air-mass sensor Signal too low	73	7 3	Test: Lead to air-flow sensor term. 7 for short-circuit to ground, leads to term. 7 and term. 9 for open-circuit, leads to term. 6 and term. 9 for mutual contact. Air-flow sensor defective.	6(-), 7, 9(+)	———
Air-flow sensor/ Air-mass sensor Signal too high	74	7 4	Test: Lead to air-flow sensor term. 6 for open-circuit (note: fault code 66 also appears), leads to term. 6 and term. 7 for short-circuit to positive (5 V or battery positive). Test resistances of air-flow sensor: between term. 6 and term. 7 (deflect sensor flap): between term. 6 and term. 9: Air-flow sensor defective.	6(-), 7	 8...2500 Ω 300...550 Ω
Transmission identification Short to ground	75	7 5	Test lead for short-circuit to ground (short to ground) or switch (if fitted) permanently closed (faulty). Continue test with electronic transmission control.	8	———
No fault stored		1 2	Fault code 1-2 constantly repeated. Continue trouble-shooting with trouble-shooting chart.	—	———

Pressure regulator
* Fuel pressure 2,8...3,2 bar

Electric fuel pump
* Fuel delivery (measured in return) at least 850 cm ^{3} /30s
Supply voltage (under load): at least 12 V

Temperature sensor (air)
* Internal electrical resistance measured at air-flow sensor between term. 4 and term. 1 at ambient temperature (+15°C...+30°C): 1450...3300 Ω

Temperature sensor (engine), blue plug.
* Internal electrical resistance at ambient temperature
(+ 15° C...+ 30° C): 1450...3300 Ω
with engine at normal operating temperature (approx. + 80° C): 280....360 Ω

Solenoid-operated injection valve
* Internal electrical resistance at ambient temperature
(+ 15° C...+ 30° C): 14,5...17,5 Ω

Air-flow sensor
* Internal electrical resistance between:
term. 2 and term. 4 : 8...2500 Ω (1)
term. 3 and term. 4 : 500...1100 Ω

(1) Deflect air-flow sensor flap slowly as far as it will go.
Resistance fluctuates between the terminals of the potentiometer.

Engine-speed sensor and reference-mark sensor
* Internal electrical resistance at ambient temperature (+15°C...+30°C): 400...800 Ω
* Air gap: 0,8 ± 0,5 mm

Throttle-valve switch
* Resistance value of idle contact term.2 and term.18): 0 Ω
* Resistance value of full-load contact (term.3 and term.18) 0 Ω

Pressure sensor (altitude sensor)
* Total resistance between term.3 and term.2 : 2300...2500 Ω
* Resistance between wiper term.1 and term.2 : 400...2300 Ω
Test specification is altitude-dependent

Idle actuator
* Internal electrical resistance at +15°...+30°C : approx. 8 Ω

Lambda sensor
* Resistance value of heater winding 1...15 Ω

Ignition coil
* Primary resistance approx. 0 Ω
* Secondary resistance 5000...7200 Ω

Interference-suppression resistors
* High-voltage distributor rotor: 1 k Ω
The secondary side of the ignition system must be interference-suppressed with at least 5k Ω total resistance. High-voltage resistance cables are installed as standard.

TEST SPECIFICATIONS (CONTINUED)

Idle test:
Engine at normal operating temperature, switch off loads.

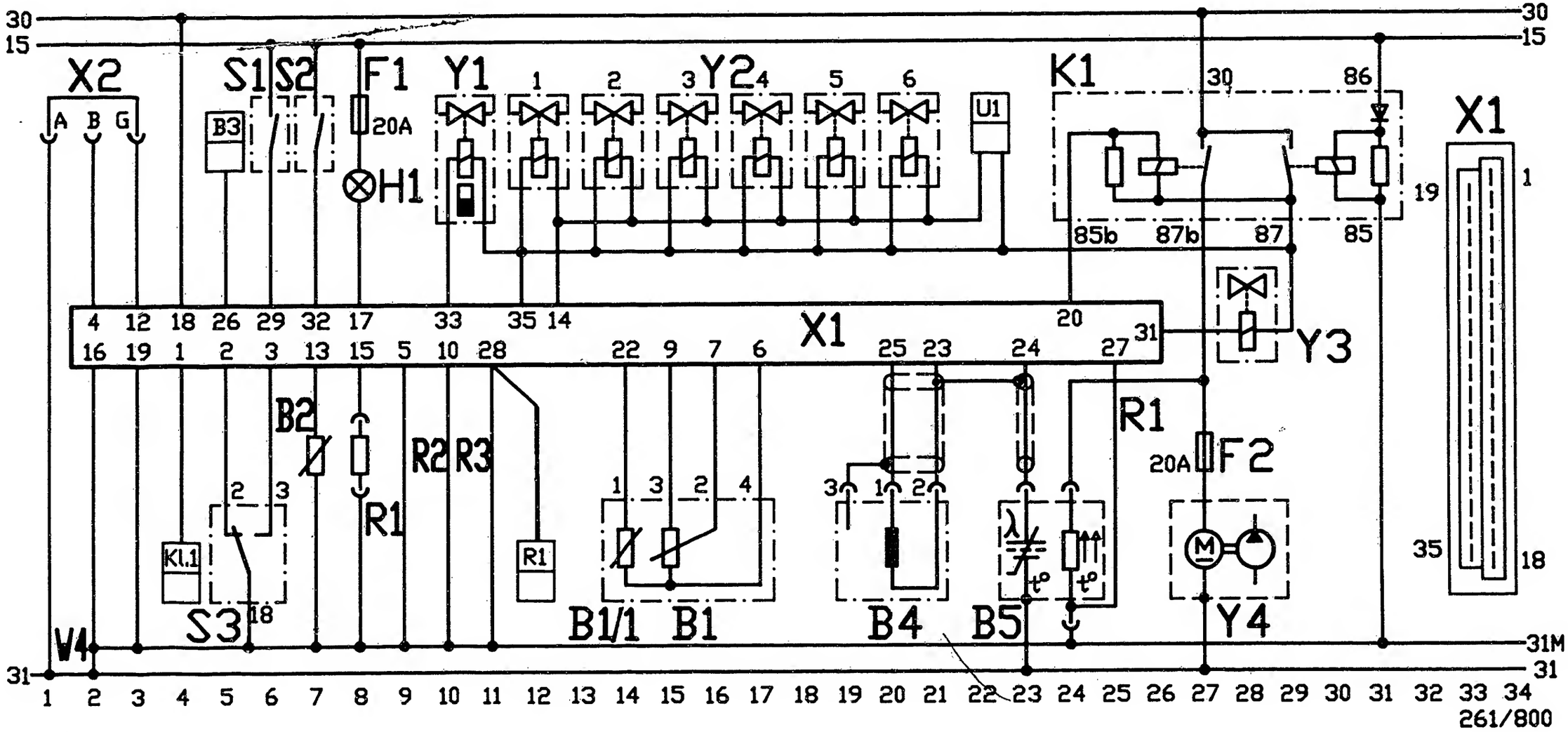
* Idle speed:	700 ± 40 min $^{-1}$	+)
* Spark-advance angle:	10 ± 5 ° crankshaft	+)

Automatic transmission to N or P

+) Attention! The basic values stated may deviate due to variant encoding. Pay attention to table in "Special Features" section.

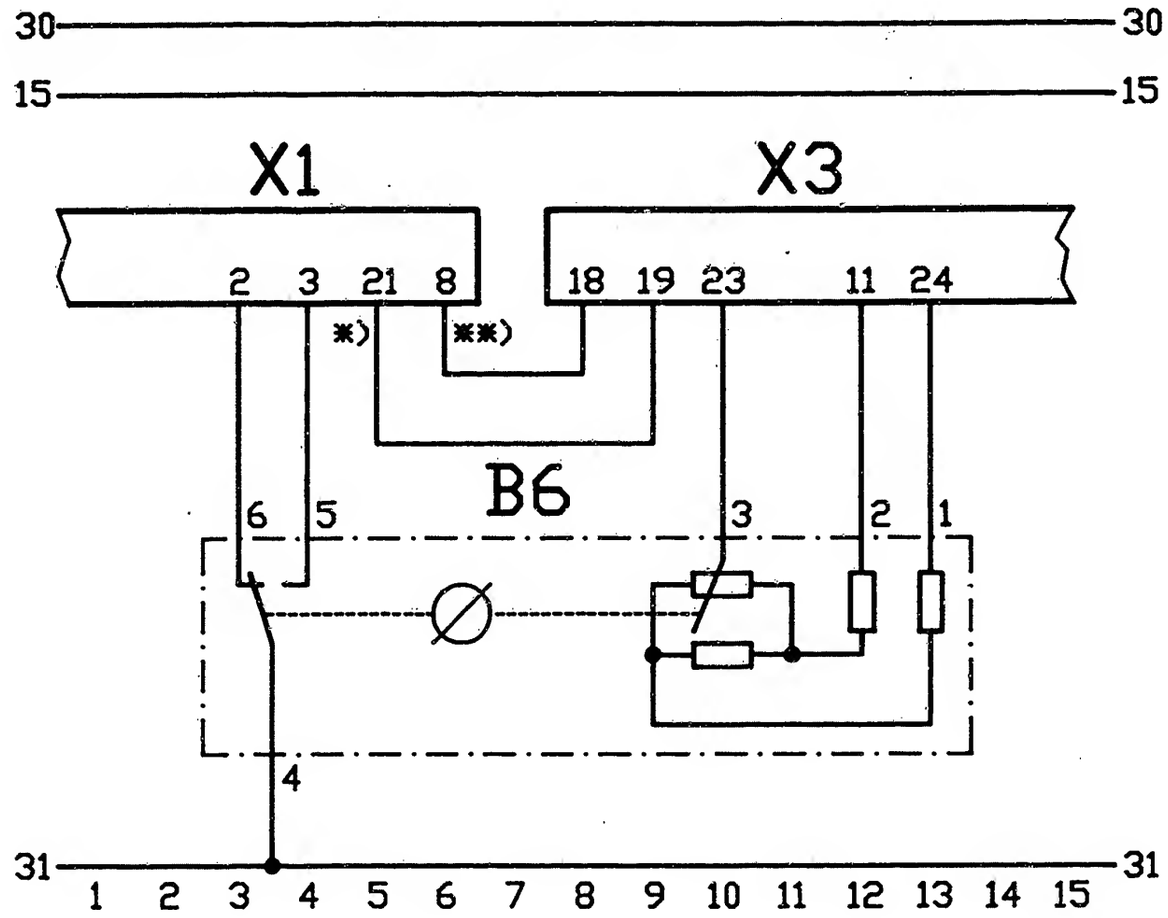
See equipment and Autodata microcards for settings for valve clearance and other engine-related data.

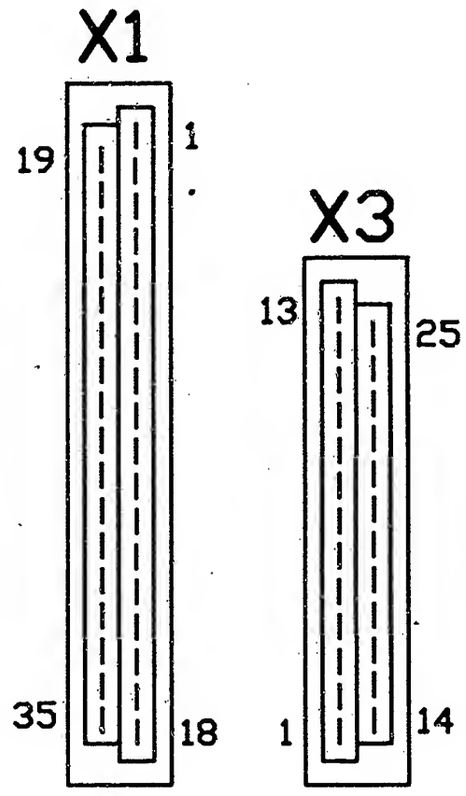
For production reasons:
continued on the following coordinate.



ELECTRICAL TERMINAL DIAGRAM

B1 = Air-flow sensor
B1/1 = Temperature sensor (air)
B2 = Temperature sensor (engine)
B3 = Distance travelled sensor
B4 = Lambda sensor
B5 = Eng.-speed/ref.-mark sensor
F1,F2 = Fuse 20A
H1 = Fault lamp
K1 = Motronic relay
Term. 1 = Ignition coil term. 1
R1 = See variant coding
R2 = For automatic transm. only
R3 = For man. shifted transm. only
S1 = Switch, compressor
S2 = Air conditioner
S3 = Throttle-valve switch
U1 = On board computer
W4 = Ground strap, engine
X1 = Motronic control-unit plug
X2 = Diagnostic plug
Y1 = Injection valve
Y2 = Tank bleeder valve
Y3 = Idle actuator
Y4 = Electric fuel pump



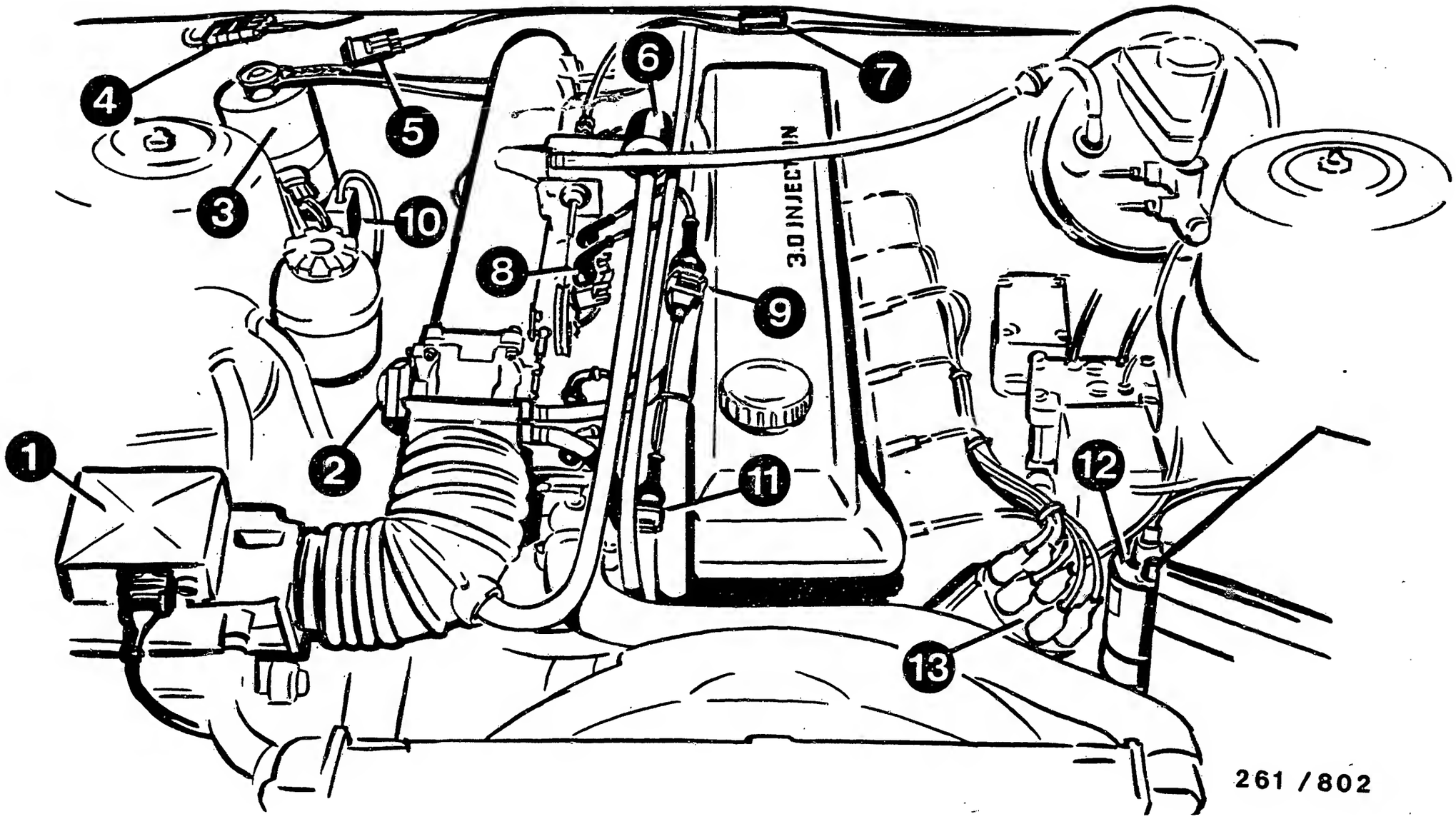


261/722

B6 = Throttle-valve switch with potentiometer for electronic transmission control
X1 = Motronic control-unit plug
X3 = Transmission control-unit plug

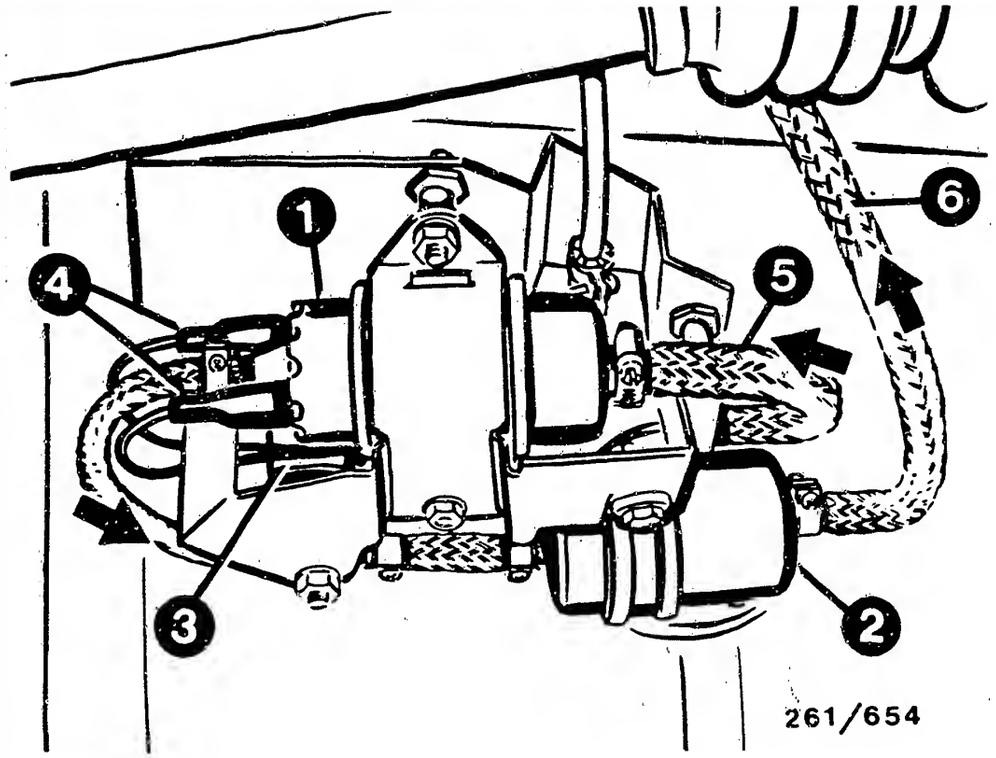
*) = Output for engine speed
**) = Input for engine action

ELECTRICAL TERMINAL DIAGRAM (CONTINUED)
Deviations for vehicles with electronic transmission control



INSTALLATION POSITION OF COMPONENTS

1 = Air-flow sensor
2 = Throttle-valve switch
3 = Activated-carbon canister
4 = Diagnostic plug
5 = Octane-rating encoding plug
6 = Rotary actuator
7 = Lambda-sensor plug-in connection
8 = Injection valves
9 = Engine-speed-sensor plug-in connection
10 = Tank-ventilation valve
11 = Temperature sensor (engine)
12 = Ignition coil
13 = High-voltage distributor



1 = Electric fuel pump
2 = Fuel filter
3 = Pressure damper
4 = Electrical connections

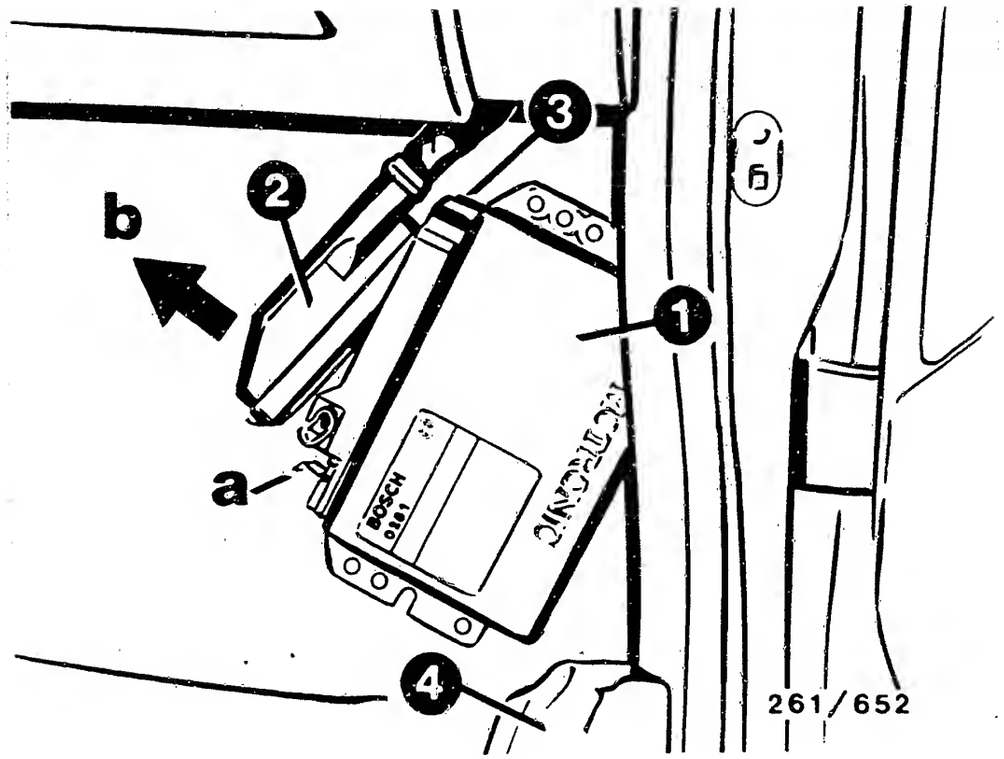
INSTALLATION POSITION OF COMPONENTS (CONTINUED)

* Electric fuel pump and fuel filter:
  in front of the fuel tank.

* Ground terminal:
  In engine compartment at front on left-hand side on the bodywork next to the battery.

* Diagnostic plug:
  In engine compartment on right-hand side on the firewall.

* Octane-rating encoding plug:
  In engine compartment on right-hand side of the firewall.



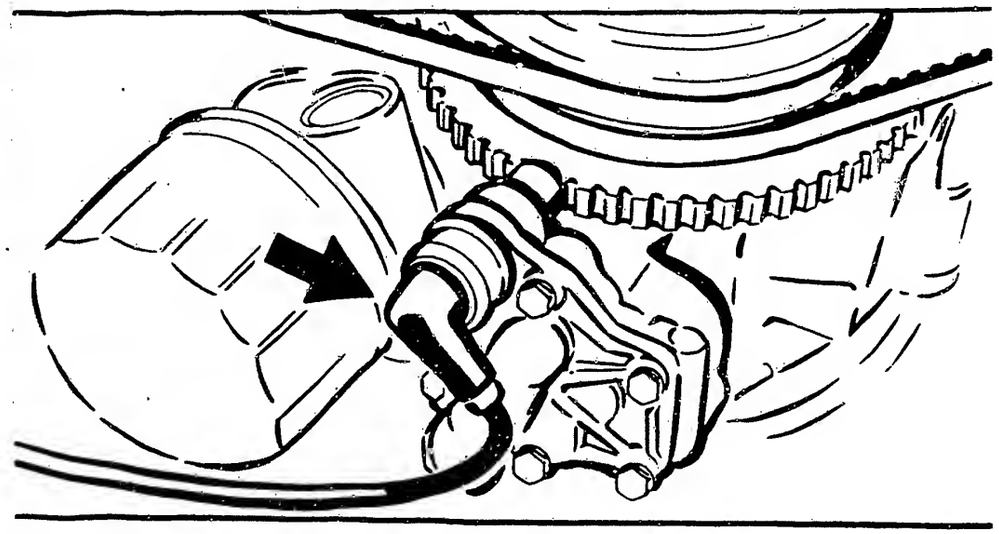
1 = Control unit
2 = Plug
3 = Mechanical encoding with lug
4 = Covering over door sill

INSTALLATION POSITION OF COMPONENTS (CONTINUED)

The indications "right" and "left" always refer to the forward direction of travel.

* Control unit:
  In passenger-side footwell on the right. Slightly lift up rubber strip and cover on door sill. Lift up floor carpet to one side and remove control-unit cover. Unscrew control unit. Unlatch plug (a), fold back (arrow b) and unhook (Item 3).

* Temperature sensor (engine):
  On engine block at the front on the right, blue plug.



261/725

Arrow = Reference-mark / engine-speed sensor

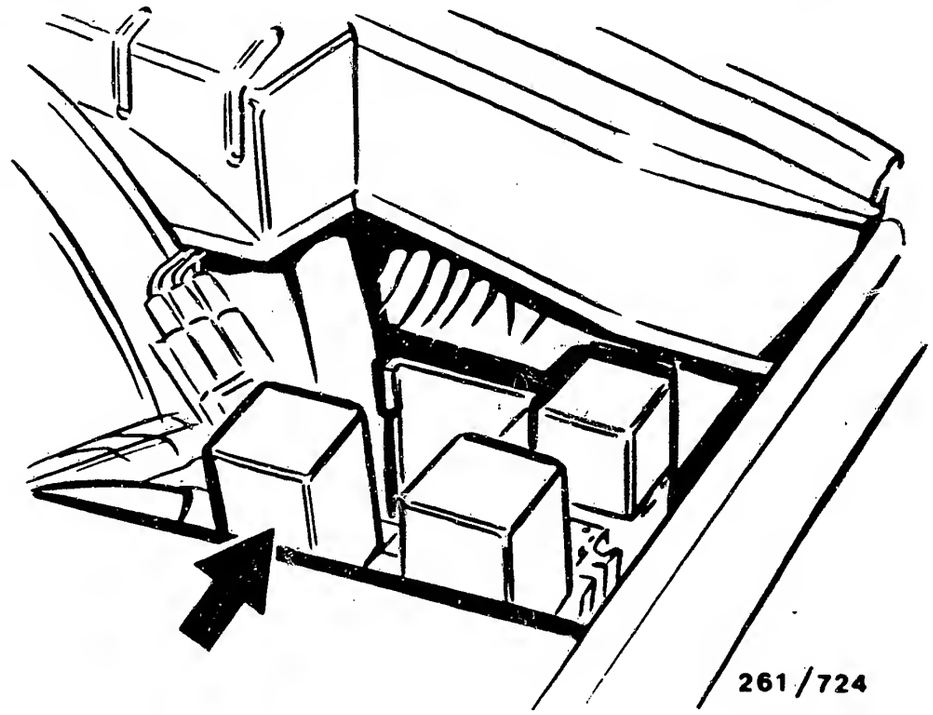
INSTALLATION POSITION OF COMPONENTS (CONTINUED)

* Reference-mark/engine-speed sensor:
  On oil-pump housing next to oil filter
  (accessible from below).

* Lambda sensor:
  In common exhaust pipe upstream of the
  catalytic converters.

* Fuses:
  In instrument panel, bottom left.
  Fuse box can be tilted open at its
  underside.

* Temperature sensor (air):
  In air-flow sensor



261/724

Arrow = Motronic relay

INSTALLATION POSITION OF COMPONENTS (CONTINUED)

* Motronic relay:
  In engine compartment on left-hand side in front of the
  firewall.

* Adjust ignition distributor:
  Remove cap and protective cover from ignition
  distributor.
  Position cylinder 1 to ignition-timing
  mark (pointer in inspection hole on cylinder
  block points to ball in flywheel).
  Center of ignition-distributor rotor must
  point to marking on housing of cylinder 1.
  If necessary, turn ignition-distributor housing;
  to do this, loosen clamping strap.

* Distance-travel frequency sensor:
  At transmission output beneath vehicle.

Trouble-shooting instructions	:	BMW5004
BOSCH system	:	Motronic M 1.1
Make of vehicle	:	BMW
Basic microcard	:	PKW-052

TABLE OF CONTENTS

SPECIAL FEATURES

These trouble-shooting instructions, valid at the time of publication, apply to the following vehicle models:

* BMW 735i with 3.5 l / 6 cyl. as of 10.86
  BMW 730i with 3.0 l / 6 cyl. as of 1.87

* Motronic system M 1.1 with self-diagnosis and flashing-code output (55-pole plug).

* The fault memory can be read out using the Pocket System Tester KTS 300 (0 684 400 300) with the program module PPG 204 as of status 09.01.89.

  Note:
  Further diagnosis possibilities (actuator diagnosis etc), which would be feasible with newer program-module statuses, are not evaluated with these vehicles.

  Pay attention to operating instructions for KTS 300. Connection of the KTS 300 to the diagnosis socket in the vehicle is via the adapter lead 1 684 463 196 (BMW).

* As an alternative to the KTS 300, the self-diagnosis can be read out by way of a flashing code (not possible with all control units).

* The self-diagnosis test table takes account of both the KTS 300 and the flashing code and is arranged according to fault-code nos. indicated by the KTS 300. In some cases, the "fault indication" column includes two types of fault which can be optionally indicated by the tester, e.g.:
  Open-circuit/short-circuit to ground (= 1st type of fault)
  Short-circuit to positive (= 2nd type of fault)

SPECIAL FEATURES (CONTINUED)

* Control unit with variant encoding.
  Important note:
  Please refer to basic instructions for information which has to be given when ordering control unit.

* Group injection: Division into 2 groups which inject at different times (except in warm-up phase and on acceleration).
  Synchronization by means of sensor on ignition cable of cyl. 6.
  Group 1: Cylinders 1, 3, 5
  Group 2: Cylinders 2, 4, 6

* Joint sensor for engine speed and reference mark.

* Adaptive lambda closed-loop control and tank ventilation with pulsed valve (for cat.).

* Control unit with built-in hold circuit (for tank ventilation valve).

* Note on trouble-shooting:
  If vehicle computer and/or burglar alarm fitted, please note the following:
  If the code for depriming the system was entered incorrectly or if there is a defect in the vehicle computer/burglar alarm, positive is switched to term. 38 of the Motronic control unit.
  The engine can then not be started.
  For rapid testing, disconnect vehicle computer and alarm-system module and repeat attempted starting (no voltage at term. 38).

SPECIAL FEATURES (CONTINUED)

Hold_circuit_for_tank ventilation valve (TEV):
As of 12.86 Motronic control units have been fitted with a hold circuit for the TEV in the 735i. This hold circuit is fitted as a general feature without assignment to vehicles with/without catalytic converter.
The hold circuit is such that, once the engine has been switched off (term. 15), the main relay remains energized for approx. 3 seconds. This means that the tank ventilation valve is closed by way of the control unit and that run-on (dieseling) is prevented.

To realise the hold circuit, BMW initially introduced a new wiring harness with auxiliary adapter.
The auxiliary adapter (BMW-No. 1 718 200) provides the necessary connections with the control unit, main relay and term. 15. As of 1.87 the hold circuit has been integrated into the wiring harness, i.e. there is no auxiliary adapter.

Motronic control units up to date of manufacture 651 can be used with the new wiring harness if the auxiliary adapter is removed and plugs B and C are connected together. Plug A remains open.
Plug A = 2-pole to control unit term. 27 and 36
Plug B = 3-pole pin housing
Plug C = 3-pole socket housing

Motronic control units as of date of manufacture 652 with hold function can be used on the wiring harness without auxiliary adapter by making a connection between the control unit term. 27 and the ignition coil term.15 (see terminal diagrams). The hold function is however not activated.
Note: Fit modified encoding plug in instrument cluster.

STRUCTURE AND USAGE

These brief instructions encompass essentially vehicle-specific special features and test specifications (set values).

In accordance with the customer complaint, the trouble-shooting chart leads to different causes/component faults.
For a detailed description of trouble-shooting, see the information in the trouble-shooting chart of the basic instructions.

ATTENTION! Even if reference is made to basic instructions, the set values, terminal assignments and special features of these vehicle-related brief instructions are always binding.

SAFETY AND PRECAUTIONARY MEASURES

In order to keep persons out of danger and to avoid damage to the engine, trigger boxes and control units or to the ignition system, observe the information in the basic instructions.

CAUTION!
High-performance ignition system with dangerous primary and secondary voltages!

Touching voltage-carrying components or terminals may prove fatal (both on the primary and secondary sides).

* Injection and high-voltage flashovers are to be avoided when testing compression.
  The main relay is therefore to be detached.

TROUBLE-SHOOTING CHART

Customer complaints (symptoms of trouble)

1. Starting motor operates, engine fails to start or starts only with difficulty.	2. Engine starts but but then dies.	3. Rough idling (engine speed, exhaust gas).	4. Poor throttle response, flat spot during acceleration.	5. Engine misfiring (ignition, fuel injection).	6. Maximum engine power/ top speed not reached.	7. Fuel consumption too high.	8. Engine running on (dieseling).	9. Engine pinging/knocking.	10. Engine overheating.	11. Fault lamp.	Cause (component fault)
*	*	*	*	*	*	*	*	*	*		Self-diagnosis
*											Voltage at control unit
*											Engine-speed/reference mark sensor
*		*			*	*					Fuel pressure
*		*				*	*				Solenoid-operated injection valves
		*	*		*						Throttle-valve switch
	*	*	*	*	*	*					Air-flow sensor
	*	*	*								Idle actuator
*	*	*	*								Air-intake system
		*									Idle speed, CO
*		*		*	*						Ignition coil
*		*	*	*	*						Primary signal
		*	*	*	*	*					Secondary pattern
*	*	*	*		*	*		*	*		Ignition point
*				*							High-voltage sensor
		*									Overrun cut-off
		*	*	*							Interference-suppression resistors
		*	*	*							Noise test
					*						Interference
					*						Throttle valve
					*						Fuel delivery
	*	*	*				*				Tank vent
		*	*								Lambda closed-loop control
*	*	*	*	*	*	*	*	*	*		Control unit

SELF-DIAGNOSIS TEST TABLE

Pocket system tester Fault indication	Fault code	Flashing code	Test instructions/Test conditions	Terminals	Set values
Data exchange not possible	—	——	Prerequisite for fault output: Leads to diagnosis plug/fault lamp and power supply for control unit O.K.	13 55 15	——
Control unit Digital sec.(comput) defective	1	1211	Control unit defective.	——	——
Relay Fuel pump Op.circ/grnd short Short to B+	3	1261	Fault 1: Short-circuit to ground or open-circuit (op. circ). Fault 1 is only detected if other output stages are defective. Fault 2: Short-circuit to positive (Short to B+): Detach pump relay and measure voltage (with respect to ground) in frame (term. 86) with ignition on: Resistance of relay coil (term. 85/86): Test lead to control unit (term. 3).	3	10....15 V Approx. 50...150 Ω
Idle actuator ZWD winding 1/EWD Op.circ/grnd short Short to B+	4	1262	Fault code 4 points to current path from control unit term. 4 to idle actuator term. 3. Test leads and plug connection of actuator for open-circuit (op. circ), short-circuit to ground and short-circuit to positive (short to B+). Winding resistance of 1st winding at +15...+30°C between connections 3 and 2:	4	17... 23 Ω
Valve Tank ventilation Op.circ/grnd short Short to B+	5	1263	Only CAT models have tank ventilation valve. Test lead for contact with ground or positive Valve winding resistance at +15...+30°C: If lead and valve O.K., control unit is defective. Open-circuit (op. circ) is not detected!	5	35... 55 Ω
Air-flow sensor/ Air-mass sensor Signal too low Signal too high	7	1215	Signal too low: Test lead to term. 2 for short-circuit to ground. Open-circuit in leads to term. 2 and term. 3 or term. 4 and term. 3 jumpered. Signal too high: Test lead to term. 4 for open-circuit. Test leads to term. 4 and term. 2 for short-circuit to positive. Continued on next Coordinate.	7 12 26	——

SELF-DIAGNOSIS TEST TABLE (CONTINUED)

Pocket system tester Fault indication	Fault code	Flashing code	Test instructions/Test conditions	Terminals	Set values
Air-flow sensor/ Air-mass sensor			Basic tests: previous coordinates continued. Test resistances at air-flow sensor:		
Signal too low			between term. 2 and term. 4 (deflect sensor flap):		8...2500 Ω
			between term. 3 and term. 4:		500...1100 Ω
Signal too high			Measure wiper voltage at term. 2 with plug connected and ignition switched on: Sensor flap in off position:		0,2... 0,3 V
			Slowly deflect sensor flap as far as full load:		Greater than 4,2 V
Lambda control			Test CO content (ahead of catalytic converter):	——	0,2... 1,2 vol. %
outside min. range	10	1222	Test intake system for leaks. Test fuel pressure.		
outside max. range			Injection valves defective. Sensor defective.		
Fault lamp	15	——	Test lead to fault lamp (if provided) for short-circuit to ground and short circuit to positive (short to B+). Open-circuit (op. circ) is not detected!	15	——
Op.circ/grnd short					
Short to B+					
Injectors (Group 2)	16	1252	Fault: Short-circuit to ground, to positive or open-circuit (op. circ) in joint positive/negative lead. Test injection valves of cyl. 1, 3, 5 for short-circuit/ open-circuit; if O.K., control unit is defective Note: Open-circuits in individual injection valves are not detected.	16	4,8... 5,7 Ω (3 valves in parallel) 14,5... 17 Ω (1 injection valve)
Op.circ/grnd short					
Short to B+					
Injectors (Group 1)	17	1251	Fault: Short-circuit to ground, to positive or open-circuit (op. circ) in joint positive/ negative lead. Test injection valves of cyl. 2, 4, 6 for short-circuit/open-circuit; if O.K., control unit is defective Note: Open-circuits in individual injection valves are not detected.	17	4,8... 5,7 Ω (3 valves in parallel) 14,5... 17 Ω (1 injection valve)
Op.circ/grnd short					
Short to B+					
Idle actuator ZWD Winding 2	22	1262	Fault code 22 points to current path from control unit term. 22 to idle actuator term. 1. Test leads and plug connection of actuator for open-circuit (op. circ), short-circuit to ground and short-circuit to positive (short to B+). Winding resistance of 2nd winding at +15...+30°C	22	
Op.circ/grnd short					
Short to B+			between connections 1 and 2:		19... 25 Ω

SELF-DIAGNOSIS TEST TABLE (CONTINUED)

Pocket system tester Fault indication	Fault code	Flashing code	Test instructions/Test conditions	Terminals	Set values
Lambda sensor Open circuit Ground short Short to B+	28	1221	Test lead for open-circuit, short-circuit to ground and short-circuit to positive (short to B+). Watch out for worn cable insulation! Sensor heater defective. Sensor clogged.	28	———
Speed signal incorrect/no signal	29	——	Test lead for open-circuit, short-circuit to ground and short-circuit to positive. If leads and plug connections are O.K., continue trouble-shooting in instrument cluster.	29	———
Battery voltage too low too high	37	1231	Supply voltage for control unit too low: Test voltage dips at positive and ground terminal. Charge battery. Supply voltage for control unit too high: Test alternator regulator.	37 19 (+) (-)	Greater than 10 V (with engine running) Less than 16 V (with engine running)
ASR/MSR interface Short to B+	38	——	Test lead to vehicle computer/burglar alarm for short-circuit to positive (short to B+). If lead and plug connections are O.K., continue trouble-shooting in vehicle computer or in burglar alarm.	38	———
Air cond. readiness/AC compr. sign. Comparison not O.K.	40	——	Test lead from control unit term. 40 to A/C compressor for short-circuit to positive. Test lead from control unit term. 41 to A/C switch (A/C readiness) for open-circuit.	40 41	———
Air-temp. sensor Op. circ./sh. to B+ Short to ground	44	1224	Test temperature sensor and lead for open-circuit (op. circ.), short-circuit to ground (short to ground) and short-circuit to positive (short to B+). Temperature-sensor resistance: at +15...+30°C:	44	1450...3300 Ω
Engine temp. sensor Op. circ./sh. to B+ Short to ground	45	1223	Test temperature sensor and lead for open-circuit (op. circ.), short-circuit to ground (short to ground) and short-circuit to positive (sh. to B+). Temperature-sensor resistance: at +15...+30°C: at approx. +80°C:	45	1450...3300 Ω 280... 360 Ω
Transmission identification Short to ground	51	1278	Applies to electronic transmission control (GS): Test lead for short-circuit to ground (short to ground) or corresponding output in transmission control unit defective. Term. 51 is open on vehicles without GS.	51	———

SELF-DIAGNOSIS TEST TALE (CONTINUED)

Pocket system tester Fault indication	Fault code	Flashing code	Test instructions/Test conditions	Terminals	Set values
Idle switch Short to ground	52	1232	Fault: Idle contact (in throttle-valve switch) permanently closed or short-circuit to ground (short to ground) in lead. Idle contact closed in off position: Actuate throttle valve somewhat:	52	 Approx. 0 Ω Infinity Ω
Full-load switch Short to ground	53	1233	Fault: Full-load contact (in throttle-valve switch) permanently closed or short-circuit to ground (short to ground) in lead. Full-load contact closed in full-throttle position: Release accelerator pedal somewhat:	53	 Approx. 0 Ω Infinity Ω
Converter clutch/ Driving pos. switch Comparison not O.K.	54 (24)	——	Note: Fault code 24 corresponds to fault code 54 Applies to electronic transmission control (GS): Test lead from control unit term. 54 for short-circuit to ground. If lead O.K., continue trouble-shooting in electronic transmission control. Term. 54 is open on vehicles without GS.	54	——
CU output stages with fin.cntling el. defective	100	——	CU = Control unit. Test following components and leads for open-circuit, short-circuit to ground and short-circuit to positive: Idle actuator, injection valves, fuel pump relay, tank ventilation valve and fault lamp if fitted.	4 22 16 17 3 5 15	——
No fault stored		4444 or 1444	Continue trouble-shooting with trouble-shooting chart.	——	——

Pressure regulator	
Fuel pressure	2,8...3,2 bar
Electric fuel pump	
Delivery (measured in return)	at least 950 cm ^{3} /30s
Supply voltage (under load):	at least 12 V
Temperature sensor (intake air)	
Internal electrical resistance measured in air-flow sensor between term. 1 and term. 4 at ambient temperature (+15°C...+30°C):	1450...3300 Ω
Temperature sensor (engine)	
Color of plug, blue. Internal electrical resistance at ambient temperature (+ 15° C...+ 30° C):	1450...3300 Ω
with engine at normal operating temperature (approx. +80°C):	280...360 Ω
Solenoid-operated injection valve	
Internal electrical resistance at ambient temperature (+ 15° C...+ 30° C):	14,5...17 Ω
Air-flow sensor	
Internal electrical resistance between:	
term. 2 and term. 4:	8...2500 Ω (*)
term. 3 and term. 4:	500...1100 Ω

(*) Slowly deflect the sensor flap as far as it will go. Fluctuating increase in resistance with slight decrease towards end.

Engine-speed and reference-mark sensor	
Internal electrical resistance between term. 1 and term. 2 at ambient temperature (+15°C...+30°C):	400...800 Ω
Air gap:	0,8±0,5 mm
Throttle-valve switch	
Resistance value of idle contact (term. 2 and term. 18):	0 Ω
Resistance value of full-load contact (term. 3 and term. 18):	0 Ω
Idle actuator	
Internal electrical resistance at +15°...+30°C between	
term. 1 and term. 2:	19...25 Ω
term. 3 and term. 2:	17...22,5 Ω
Lambda sensor	
Resistance value of heater winding:	1...15 Ω
Ignition coil	
Primary resistance: approx.	0 Ω
Secondary resistance:	5000...7200 Ω
Interference-suppression resistors	
High-voltage-distributor rotor:	1 k Ω
High-voltage-distributor dome: each	1 k Ω
Spark-plug connector: each	5 k Ω
Spark plugs:	5 k Ω
Ignition coil:	1 k Ω

TEST SPECIFICATIONS (CONTINUED)

High-voltage sensor:
Internal electrical resistance
between term. 1 and term. 2: approx. 0 Ω

Tank-ventilation valve:
(only in vehicles with catalytic converter)
Internal electrical resistance at
ambient temperature (+15°C...+30°C): 35...55 Ω

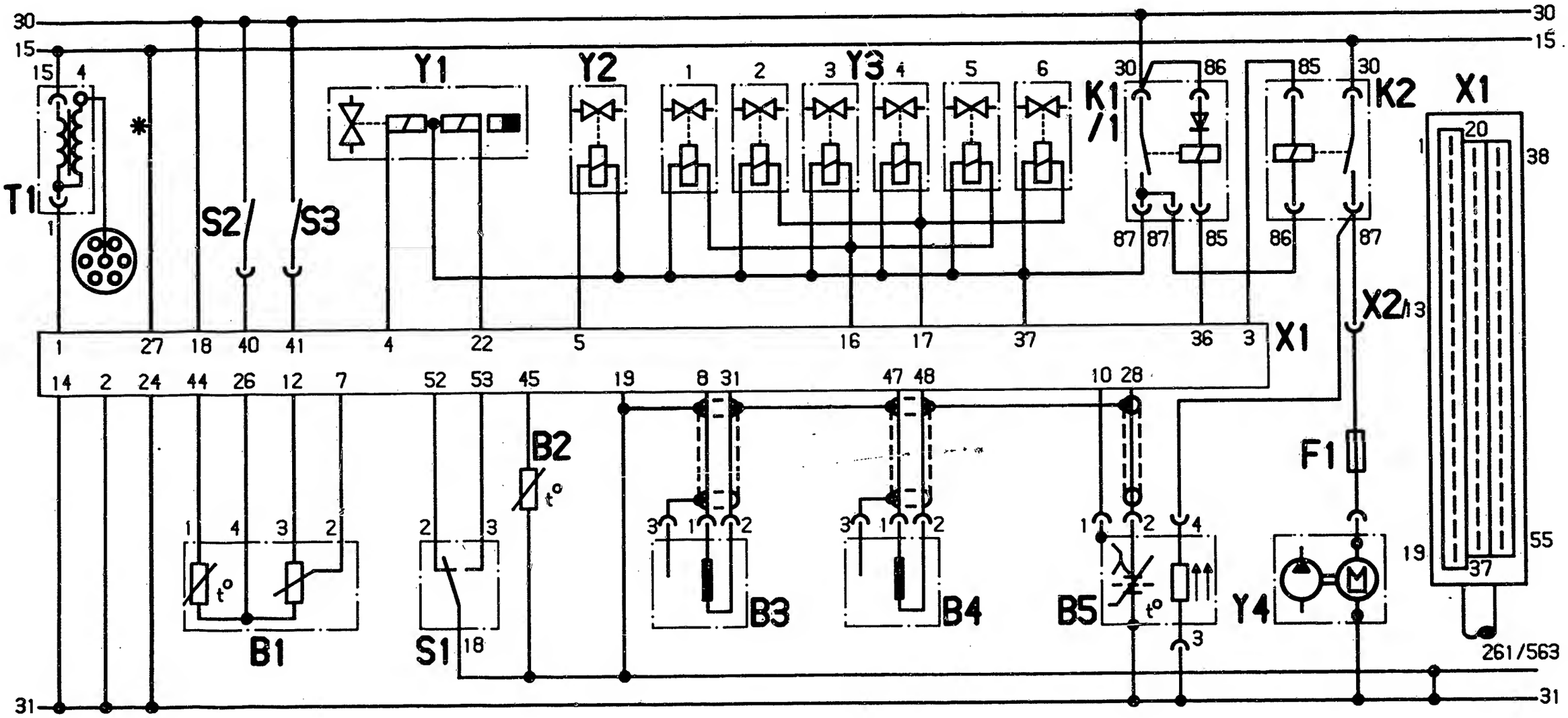
Idle test:
Engine at normal operating temperature,
switch off loads.
Idle speed: 800±40 min $^{-1}$
Spark-advance angle: 10±5°
crankshaft
(Automatic transmission to N or P)

CO content: without
catalytic converter: 0,5...1,5 % CO by vol.
Adjust mixture at the bypass screw
in the air-flow sensor:
turning to the left makes mixture leaner,
turning to the right makes mixture richer.

Vehicles with
catalytic converter: 0,2...1,2 % CO by vol.
(measure CO upstream of the catalytic
converter if sampling pick-up fitted,
pull apart lambda-sensor plug).

See equipment and Autodata microcards for
the settings for valve clearance and other
engine-related data.

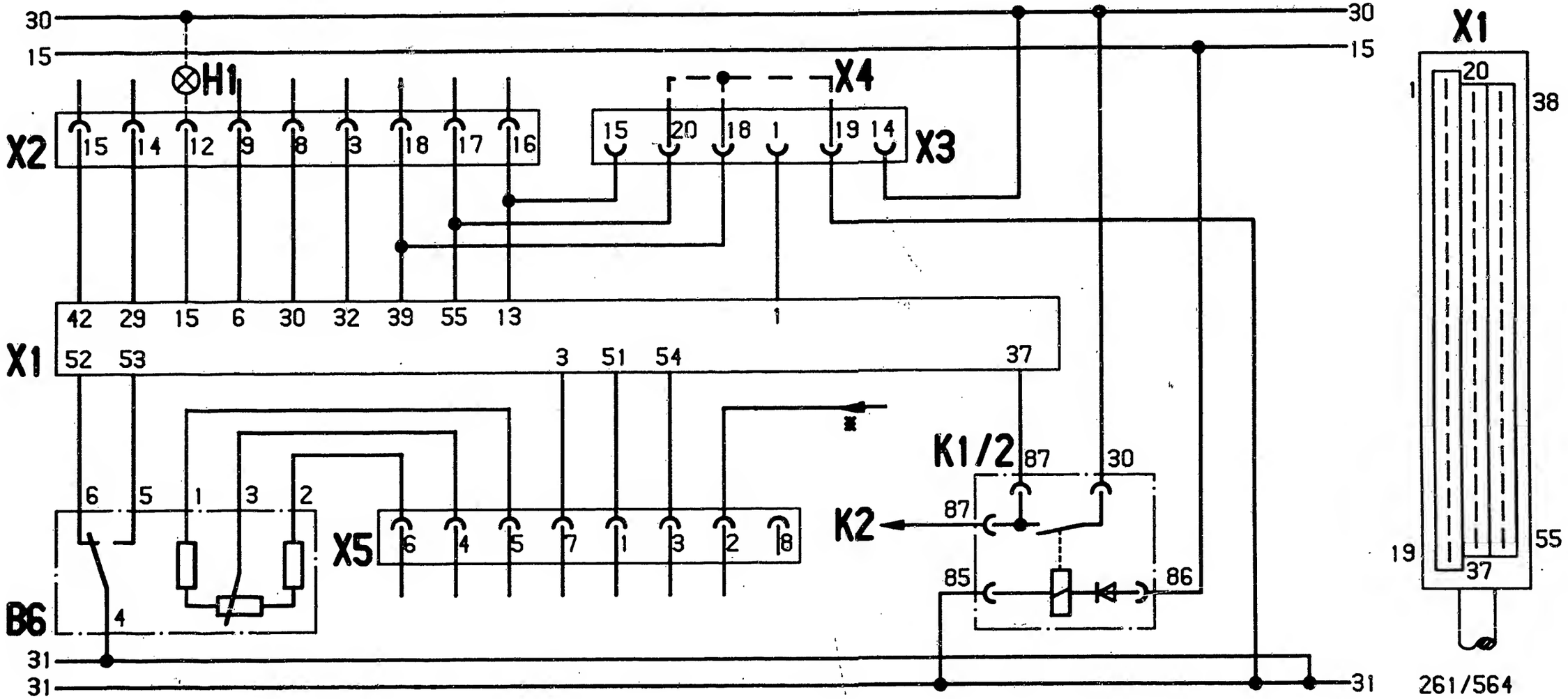
For production reasons:
continued on the following
coordinate.



ELECTRICAL TERMINAL DIAGRAM (5 and 6 Series)

B1 = Air-flow sensor
B2 = Engine-temperature sensor
B3 = High-voltage sensor
B4 = Engine-speed/reference-mark sensor
B5 = Heated lambda sensor (Cat only)
F1 = Pump fuse
K1/1 = Main relay (circuitry as of 12.86)
K2 = Pump relay
S1 = Throttle-valve switch
S2 = Switch on air-conditioner compressor
S3 = Switch on air conditioner
T1 = Ignition coil
X1 = Motronic control-unit plug
Y1 = Idle actuator
Y2 = Tank-ventilation valve (Cat only)
Y3 = Solenoid-operated injection valve
Y4 = Electric fuel pump

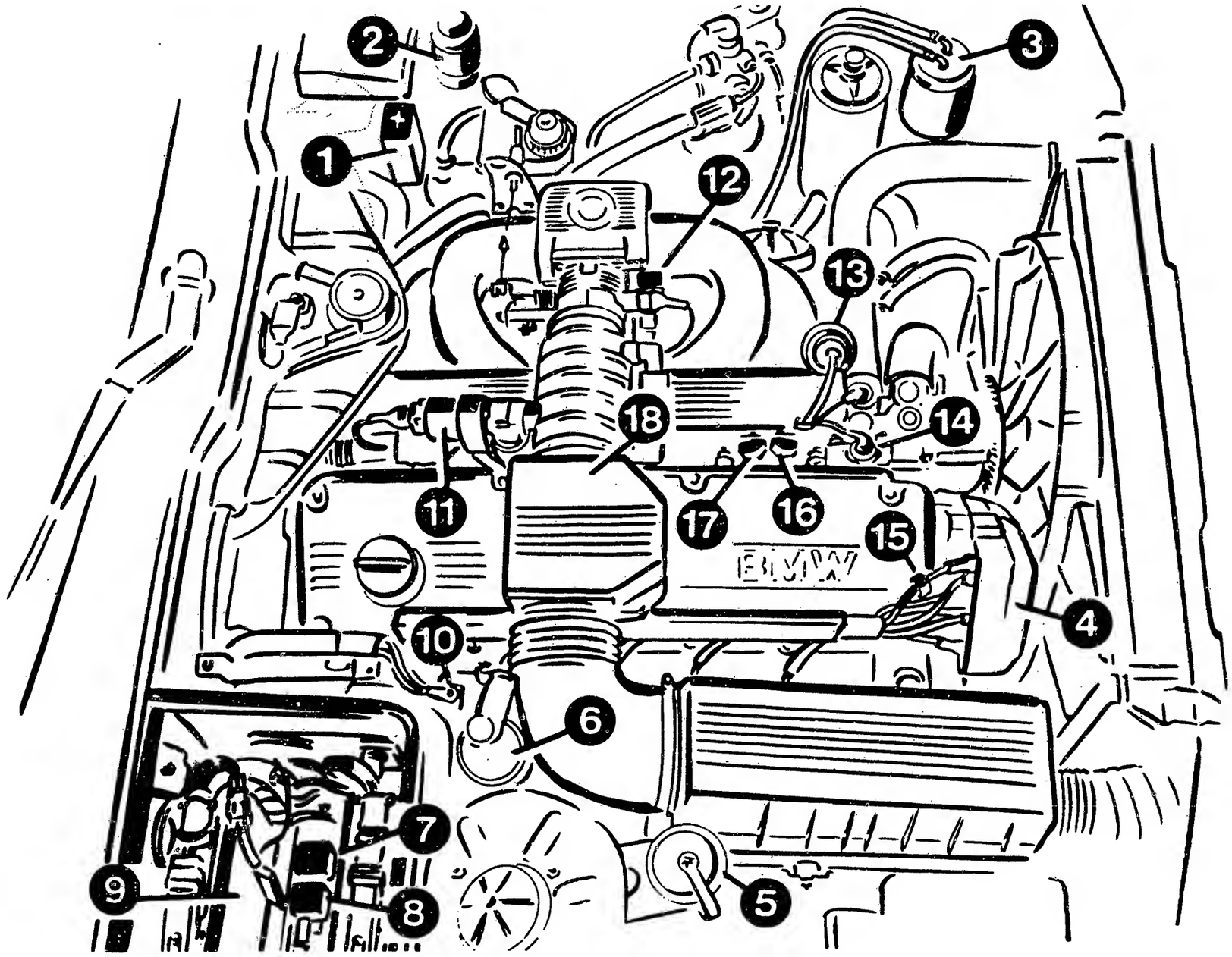
*) = Lead as of FD 652



ELECTRICAL TERMINAL DIAGRAM (1)

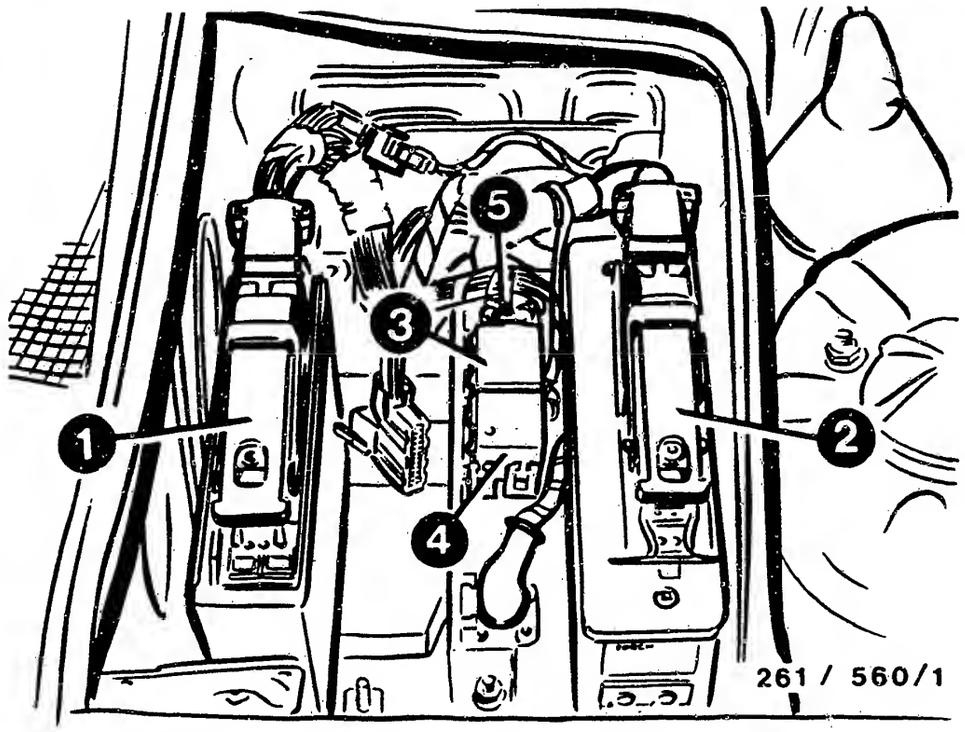
B6 = Throttle-valve switch with potentiometer (with electronic trans. control instead of Item S1)
H1 = "CARB" lamp (indicator lamp; US version)
K1/2 = Main relay (circuit up to 12.86)
K2 = Pump relay
* = From main relay term. 87 (+)

X1 = Motronic control-unit plug
X2 = Engine plug (20-pin)
X3 = Diagnostic plug (20-pin)
X4 = Bridge in diagnostic-plug cover
X5 = 8-pin plug to transmission control unit



INSTALLATION POSITION OF COMPONENTS

1 = Positive battery terminal
2 = Engine plug
3 = Active-carbon container (cat. only)
4 = High-tension distributor
5 = Diagnosis socket
6 = Ignition coil
7 = Main relay
8 = Pump relay
9 = Motronic control unit
10 = Motronic ground terminal
11 = Idle actuator
12 = Throttle-valve switch
13 = Fuel-pressure regulator
14 = Engine-temperature sensor
15 = High-tension sensor (cyl. 6)
16 = Plug, high-tension sensor
17 = Plug, speed/ref. mark sensor
18 = Air-flow sensor



1 = Motronic control unit
2 = ABS control unit
3 = Main relay
4 = Pump relay
5 = Plug connection, if transmission control fitted

INSTALLATION POSITION OF COMPONENTS (1)

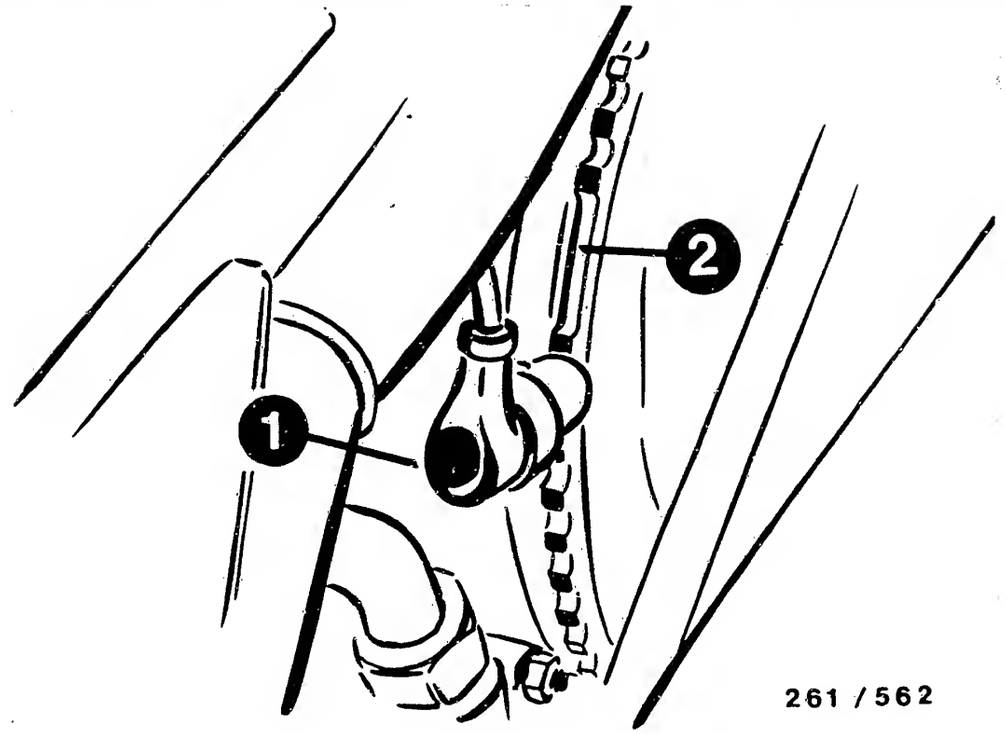
The installation position given is always as viewed from behind the vehicle.

Control unit:
In the instrument compartment beneath the hood (E box on the right-hand firewall). Unscrew cap.

Main relay:
In the instrument compartment. White relay housing.

Pump relay:
In the instrument compartment. Orange relay housing.

Air-temperature sensor:
In the air-flow sensor.



1 = Engine-speed/reference-mark sensor
2 = Ring gear with gap

Electric fuel pump:
In the fuel tank.

Fuel filter:
Beneath the vehicle, in front of the fuel tank on the right.

Reference-mark/engine-speed sensor:
At front of engine, to the right of the crankshaft ring gear.
Plug connection between the injection valves of cylinders 1 and 2 (left-hand plug connection).

Ground terminal:
Next to the instrument compartment on the left, beneath a cap, close to the igniton coil.

INSTALLATION POSITION OF COMPONENTS (3)

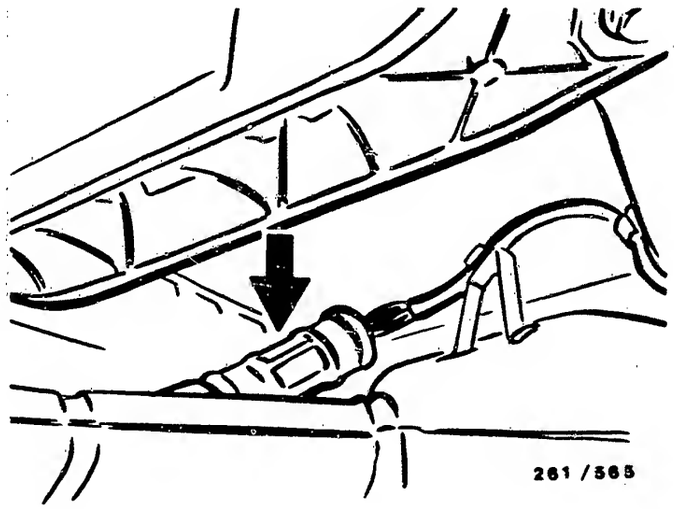
Lambda sensor:
In the common exhaust pipe (arrow, top picture). Round plug connection, 4-pin beneath the starting motor (arrow, center picture).

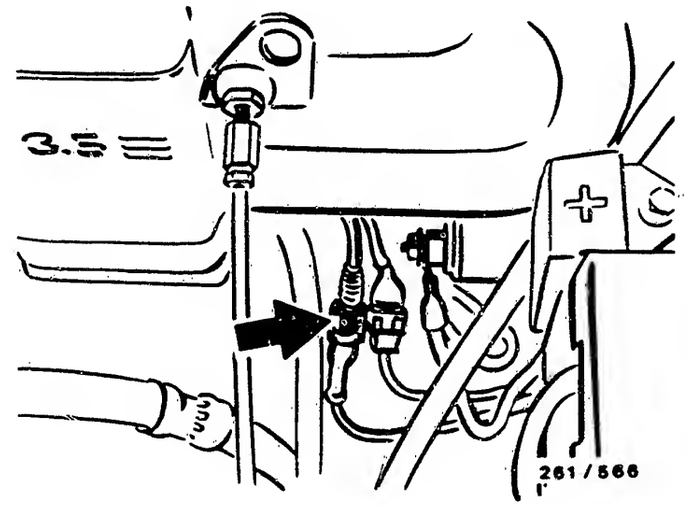
Tank vent valve:
Mounted on intake manifold in engine compartment, close to oil dipstick (arrow, bottom picture).

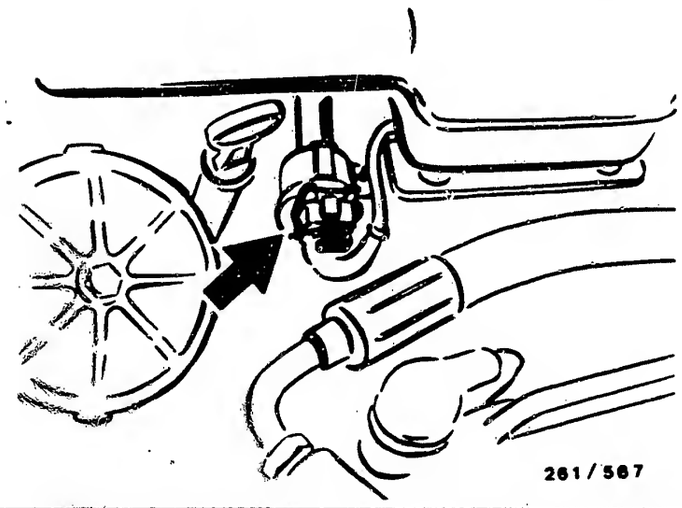
Fuse no. 23 for electric fuel pump:
In the fuse box on the left-hand firewall.

High-tension sensor:
On ignition cable for cylinder 6.
Plug connection between the injection valves of cylinders 1 and 2 (right-hand plug connection).

Battery:
Beneath the rear seat bench.







Trouble-shooting instructions : BMW-5005

BOSCH system : Motronic M 1.1

Make of vehicle : BMW

Basic microcard : PKW-052

TABLE OF CONTENTS

SPECIAL FEATURES

These trouble-shooting instructions, valid at the time of publication, apply to the following vehicle models:

* BMW 320i, 520i with 2.0 l / 6 cyl. as of 1.87
  BMW 325i, 325iX with 2.5 l / 6 cyl. as of 1.87
  BMW 325e, 525e with 2.7 l / 6 cyl. as of 1.87

* Motronic system M 1.1 with self-diagnosis and flashing-code output (55-pole plug).

* The fault memory can be read out using the Pocket System Tester KTS 300 (0 684 400 300) with the program module PPG 204 as of status 09.01.89.

  Note:
  Further diagnosis possibilities (actuator diagnosis etc), which would be feasible with newer program-module statuses, are not evaluated with these vehicles.

  Pay attention to operating instructions for KTS 300. Connection of the KTS 300 to the diagnosis socket in the vehicle is via the adapter lead 1 684 463 196 (BMW).

* As an alternative to the KTS 300, the self-diagnosis can be read out by way of a flashing code (not possible with all control units).

The self-diagnosis test table takes account of both the KTS 300 and the flashing code and is arranged according to fault code nos. indicated by the KTS 300. In some cases, the "fault indication" column includes two types of fault which can be optionally indicated by the tester, e.g.:

Open-circuit/short-circuit to ground (= 1st type of fault)
Short-circuit to positive (= 2nd type of fault)

SPECIAL FEATURES (CONTINUED)

* Control unit with variant encoding.
  Important note:
  Please refer to basic instructions for information which has to be given when ordering control unit.

* Group injection: Division into 2 groups which inject at different times (except in warm-up phase and on acceleration).
  Synchronization by means of sensor on ignition cable of cyl. 6.
  Group 1: Cylinders 1, 3, 5
  Group 2: Cylinders 2, 4, 6

* Joint sensor for engine speed and reference mark.

* Adaptive lambda closed-loop control and tank ventilation with pulsed valve (for cat.).

* Control unit with built-in hold circuit (for tank ventilation valve).

* Note on trouble-shooting:
  If vehicle computer and/or burglar alarm fitted, please note the following:
  If the code for depriming the system was entered incorrectly or if there is a defect in the vehicle computer/burglar alarm, positive is switched to term. 38 of the Motronic control unit.
  The engine can then not be started.
  For rapid testing, disconnect vehicle computer and alarm-system module and repeat attempted starting (no voltage at term. 38).

STRUCTURE AND USAGE

These brief instructions encompass essentially vehicle-specific special features and test specifications (set values).

In accordance with the customer complaint, the trouble-shooting chart leads to different causes/component faults.
For a detailed description of trouble-shooting, see the information in the trouble-shooting chart of the basic instructions.

ATTENTION: Even if reference is made to basic instructions, the set values, terminal assignments and special features of these vehicle-related brief instructions are always binding.

SAFETY AND PRECAUTIONARY MEASURES

In order to keep persons out of danger and to avoid damage to the engine, trigger boxes and control units or to the ignition system, observe the information in the basic instructions.

CAUTION!
High-performance ignition system with dangerous primary and secondary voltages!

Touching voltage-carrying components or terminals may prove fatal (both on the primary and secondary sides).

* Injection and high-voltage flashovers are to be avoided when testing compression.
  The main relay is therefore to be detached.

TROUBLE-SHOOTING CHART

Customer complaints (symptoms of trouble)

1. Starting motor operates, engine fails to start or starts only with difficulty.	2. Engine starts but but then dies.	3. Rough idling (engine speed, exhaust gas).	4. Poor throttle response, flat spot during acceleration.	5. Engine misfiring (ignition, fuel injection).	6. Maximum engine power/ top speed not reached.	7. Fuel consumption too high.	8. Engine running on (dieseling).	9. Engine pinging/knocking.	10. Engine overheating.	11. Fault lamp.	Cause (component fault)
*	*	*	*	*	*	*	*	*	*		Self-diagnosis
*											Voltage at control unit
*											Engine-speed/reference mark sensor
*		*			*	*					Fuel pressure
*		*				*	*				Solenoid-operated injection valves
		*	*		*						Throttle-valve switch
	*	*	*	*	*	*					Air-flow sensor
	*	*	*								Idle actuator
*	*	*	*								Air-intake system
		*									Idle speed, CO
*		*		*	*						Ignition coil
*		*	*	*	*						Primary signal
		*	*	*	*	*					Secondary pattern
*	*	*	*		*	*		*	*		Ignition point
*				*							High-voltage sensor
		*									Overrun cut-off
		*	*	*							Interference-suppression resistors
		*	*	*							Noise test
					*						Interference
					*						Throttle valve
					*						Fuel delivery
	*	*	*				*				Tank vent
		*	*								Lambda closed-loop control
*	*	*	*	*	*	*	*	*	*		Control unit

For production reasons:
continued on the following
coordinate.

SELF-DIAGNOSIS TEST TABLE

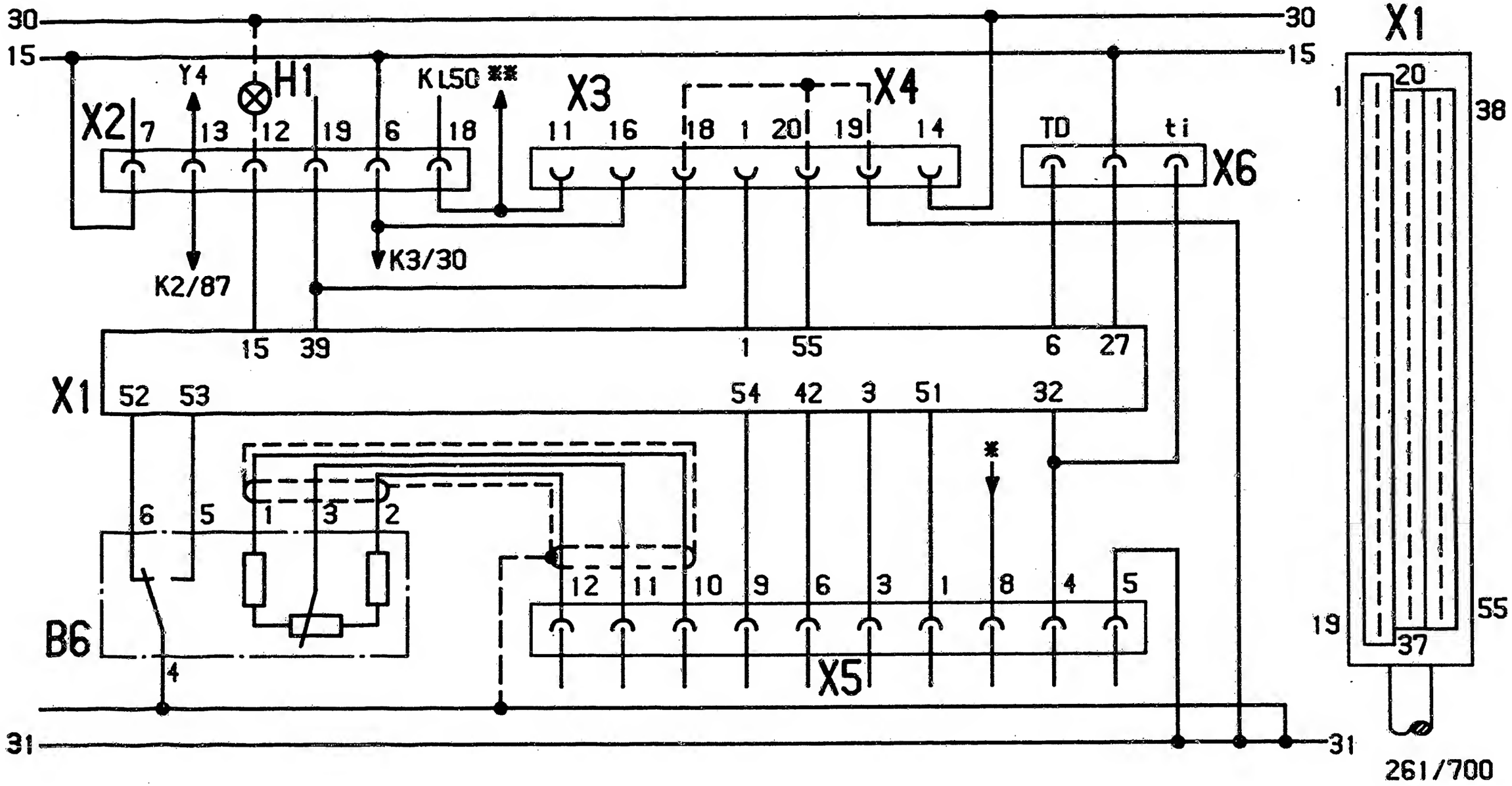
Pocket system tester Fault indication	Fault code	Flashing code	Test instructions/Test conditions	Terminals	Set values
Data exchange not possible	—	——	Prerequisite for fault output: Leads to diagnosis plug/fault lamp and power supply for control unit O.K.	13 55 15	——
Control unit Digital sec.(comput) defective	1	1211	Control unit defective.	——	——
Relay Fuel pump Op.circ/grnd short Short to B+	3	1261	Fault 1: Short-circuit to ground or open-circuit (op. circ). Fault 1 is only detected if other output stages are defective. Fault 2: Short-circuit to positive (Short to B+): Detach pump relay and measure voltage (with respect to ground) in frame (term. 86) with ignition on: Resistance of relay coil (term. 85/86): Test lead to control unit (term. 3).	3	10...,15 V Approx. 50...150 Ω
Idle actuator ZWD winding 1/EWD Op.circ/grnd short Short to B+	4	1262	Fault code 4 points to current path from control unit term. 4 to idle actuator term. 3. Test leads and plug connection of actuator for open-circuit (op. circ), short-circuit to ground and short-circuit to positive (short to B+). Winding resistance of 1st winding at +15...+30°C between connections 3 and 2:	4	17... 23 Ω
Valve Tank ventilation Op.circ/grnd short Short to B+	5	1263	Only CAT models have tank ventilation valve. Test lead for contact with ground or positive Valve winding resistance at +15...+30°C: If lead and valve O.K., control unit is defective. Open-circuit (op. circ) is not detected!	5	35... 55 Ω
Air-flow sensor/ Air-mass sensor Signal too low Signal too high	7	1215	Signal too low: Test lead to term. 2 for short-circuit to ground. Open-circuit in leads to term. 2 and term. 3 or term. 4 and term. 3 jumpered. Signal too high: Test lead to term. 4 for open-circuit. Test leads to term. 4 and term. 2 for short-circuit to positive. Continued on next Coordinate.	7 12 26	——

SELF-DIAGNOSIS TEST TABLE (CONTINUED)

Pocket system tester Fault indication	Fault code	Flashing code	Test instructions/Test conditions	Terminals	Set values
Air-flow sensor/ Air-mass sensor Signal too low Signal too high			Basic tests: previous coordinates continued. Test resistances at air-flow sensor: between term. 2 and term. 4 (deflect sensor flap): between term. 3 and term. 4: Measure wiper voltage at term. 2 with plug connected and ignition switched on: Sensor flap in off position: Slowly deflect sensor flap as far as full load:		 8...2500 Ω 500...1100 Ω 0,2... 0,3 V Greater than 4,2 V
Lambda control outside min. range outside max. range	10	1222	Test CO content (ahead of catalytic converter): Test intake system for leaks. Test fuel pressure. Injection valves defective. Sensor defective.	———	0,2... 1,2 vol. %
Fault lamp Op.circ/grnd short Short to B+	15	———	Test lead to fault lamp (if provided) for short-circuit to ground and short circuit to positive (short to B+). Open-circuit (op. circ) is not detected!	15	———
Injectors (Group 2) Op.circ/grnd short Short to B+	16	1252	Fault: Short-circuit to ground, to positive or open-circuit (op. circ) in joint positive/negative lead. Test injection valves of cyl. 1, 3, 5 for short-circuit/open-circuit; if O.K., control unit is defective Note: Open-circuits in individual injection valves are not detected.	16	4,8... 5,7 Ω (3 valves in parallel) 14,5... 17 Ω (1 injection valve)
Injectors (Group 1) Op.circ/grnd short Short to B+	17	1251	Fault: Short-circuit to ground, to positive or open-circuit (op. circ) in joint positive/negative lead. Test injection valves of cyl. 2, 4, 6 for short-circuit/open-circuit; if O.K., control unit is defective Note: Open-circuits in individual injection valves are not detected.	17	4,8... 5,7 Ω (3 valves in parallel) 14,5... 17 Ω (1 injection valve)
Idle actuator ZWD Winding 2 Op.circ/grnd short Short to B+	22	1262	Fault code 22 points to current path from control unit term. 22 to idle actuator term. 1. Test leads and plug connection of actuator for open-circuit (op. circ), short-circuit to ground and short-circuit to positive (short to B+). Winding resistance of 2nd winding at +15...+30°C between connections 1 and 2:	22	 19... 25 Ω

SELF-DIAGNOSIS TEST TABLE (CONTINUED)

Pocket system tester Fault indication	Fault code	Flashing code	Test instructions/Test conditions	Terminals	Set values
Lambda sensor Open circuit Ground short Short to B+	28	1221	Test lead for open-circuit, short-circuit to ground and short-circuit to positive (short to B+). Watch out for worn cable insulation! Sensor heater defective. Sensor clogged.	28	———
Speed signal incorrect/no signal	29	———	Test lead for open-circuit, short-circuit to ground and short-circuit to positive. If leads and plug connections are O.K., continue trouble-shooting in instrument cluster.	29	———
Battery voltage too low too high	37	1231	Supply voltage for control unit too low: Test voltage dips at positive and ground terminal. Charge battery. Supply voltage for control unit too high: Test alternator regulator.	37 19 (+) (-)	Greater than 10 V (with engine running) Less than 16 V (with engine running)
ASR/MSR interface Short to B+	38	———	Test lead to vehicle computer/burglar alarm for short-circuit to positive (short to B+). If lead and plug connections are O.K., continue trouble-shooting in vehicle computer or in burglar alarm.	38	———
Air cond. readiness/AC compr. sign. Comparison not O.K.	40	———	Test lead from control unit term. 40 to A/C compressor for short-circuit to positive. Test lead from control unit term. 41 to A/C switch (A/C readiness) for open-circuit.	40 41	———
Air-temp. sensor Op. circ./sh. to B+ Short to ground	44	1224	Test temperature sensor and lead for open-circuit (op. circ.), short-circuit to ground (short to ground) and short-circuit to positive (short to B+). Temperature-sensor resistance: at +15...+30°C:	44	1450...3300 Ω
Engine temp. sensor Op. circ./sh. to B+ Short to ground	45	1223	Test temperature sensor and lead for open-circuit (op. circ.), short-circuit to ground (short to ground) and short-circuit to positive (sh. to B+). Temperature-sensor resistance: at +15...+30°C: at approx. +80°C:	45	1450...3300 Ω 280... 360 Ω
Transmission identification Short to ground	51	1278	Applies to electronic transmission control (GS): Test lead for short-circuit to ground (short to ground) or corresponding output in transmission control unit defective. Term. 51 is open on vehicles without GS.	51	———



ELECTRICAL TERMINAL DIAGRAM (continued, 3 Series)

B6 = Throttle-valve switch with pot
(with electro. transm. control for Item S1)
H1 = "CARB" lamp (fault lamp; US version)
X1 = Motronic control-unit plug
X2 = Engine plug (20-pin)
X3 = Diagnostic plug (20-pin)
X4 = Jumper in diagnostic-plug cover
X5 = 13-pin plug to transmission control unit
X6 = 3-pin connector
* = from main relay term.87(+)
** = to starting motor term.50

SELF-DIAGNOSIS TEST TALE (CONTINUED)

Pocket system tester Fault indication	Fault code	Flashing code	Test instructions/Test conditions	Terminals	Set values
Idle switch Short to ground	52	1232	Fault: Idle contact (in throttle-valve switch) permanently closed or short-circuit to ground (short to ground) in lead. Idle contact closed in off position: Actuate throttle valve somewhat:	52	 Approx. 0 Ω Infinity Ω
Full-load switch Short to ground	53	1233	Fault: Full-load contact (in throttle-valve switch) permanently closed or short-circuit to ground (short to ground) in lead. Full-load contact closed in full-throttle position: Release accelerator pedal somewhat:	53	 Approx. 0 Ω Infinity Ω
Converter clutch/ Driving pos. switch Comparison not O.K.	54 (24)	——	Note: Fault code 24 corresponds to fault code 54 Applies to electronic transmission control (GS): Test lead from control unit term. 54 for short-circuit to ground. If lead O.K., continue trouble-shooting in electronic transmission control. Term. 54 is open on vehicles without GS.	54	——
CU output stages with fin.cntling el. defective	100	——	CU = Control unit. Test following components and leads for open-circuit, short-circuit to ground and short-circuit to positive: Idle actuator, injection valves, fuel pump relay, tank ventilation valve and fault lamp if fitted.	4 22 16 17 3 5 15	——
No fault stored		4444 or 1444	Continue trouble-shooting with trouble-shooting chart.	——	——

Pressure regulator
Fuel pressure 2,0/2,7 l: 2,3...2,7 bar
2,5 l: 2,8...3,2 bar

Electric fuel pump
Fuel delivery
measured in return line at least 785 cm^3 /30s
Pre-supply pump (if present) at least 865 cm^3 /30s
Supply voltage (under load): at least 12 V

Temperature sensor (intake air)
Internal electrical resistance measured at air-flow sensor between term.1 and term.4 at ambient temperature (+15°C...+30°C): 1450...3300 Ω

Temperature sensor (engine)
Plug color, blue. Internal electrical resistance at ambient temperature
(+ 15° C...+ 30° C): 1450...3300 Ω
with engine at normal operating temp. (approx. + 80° C): 280...360 Ω

Solenoid-operated injection valve
Internal electrical resistance at ambient temperature
(+ 15° C...+ 30° C): 14,5...17 Ω

Air-flow sensor
Internal electrical resistance between:
term.2 and term.4 : 8...2500 Ω (*)
term.3 and term.4 : 500...1100 Ω

(*) Slowly deflect air-flow sensor flap as far as it will go. Fluctuating increase in resistance with slight drop towards end.

Engine-speed/reference-mark sensor
Internal electrical resistance between term.1 and term.2 at ambient temperature (+15°C...+30°C): 400...800 Ω
Air gap: 0,8±0,5 mm

Throttle-valve switch
Resistance of idle contact (term.2 and term.18): 0 Ω
Resistance of full-load contact (term.3 and term.18): 0 Ω

Idle actuator
Internal electrical resistance at +15°...+30°C between
term.1 and term.2 : 19...25 Ω
term.3 and term.2 : 17...22,5 Ω

Lambda sensor
Resistance of heater winding (sockets 3 and 4 in 4-pin terminal to lambda sensor): 1...15 Ω

Ignition coil
Primary resistance: approx. 0,8 Ω
Secondary resistance: 5000...7200 Ω

Interference-suppression resistors
High-voltage-distributor rotor: 1 k Ω
High-voltage-distributor dome: each 1 k Ω
Spark-plug connector: each 5 k Ω
Spark plugs: 5 k Ω
Ignition coil: 1 k Ω

TEST SPECIFICATIONS (CONTINUED)

High-voltage sensor:
Internal electrical resistance
between term. 1 and term. 2: approx. 0 Ω

Tank-ventilation valve:
(only in vehicles with catalytic converter)
Internal electrical resistance at
ambient temperature (+15°C...+30°C): 35...55 Ω

Idle test:
Engine at normal operating temperature,
switch off loads.

Idle speed:	760 ± 40 min $^{-1}$
eta-motors	720 ± 40° ° crankshaft
Spark-advance angle:	9 ± 5° crankshaft

(Automatic transmission to N or P)

CO content: without
catalytic converter: 1,0 ± 0,5 % CO by vol.
Adjust mixture at the bypass screw
in the air-flow sensor:
turning to the left makes mixture leaner,
turning to the right makes mixture richer.

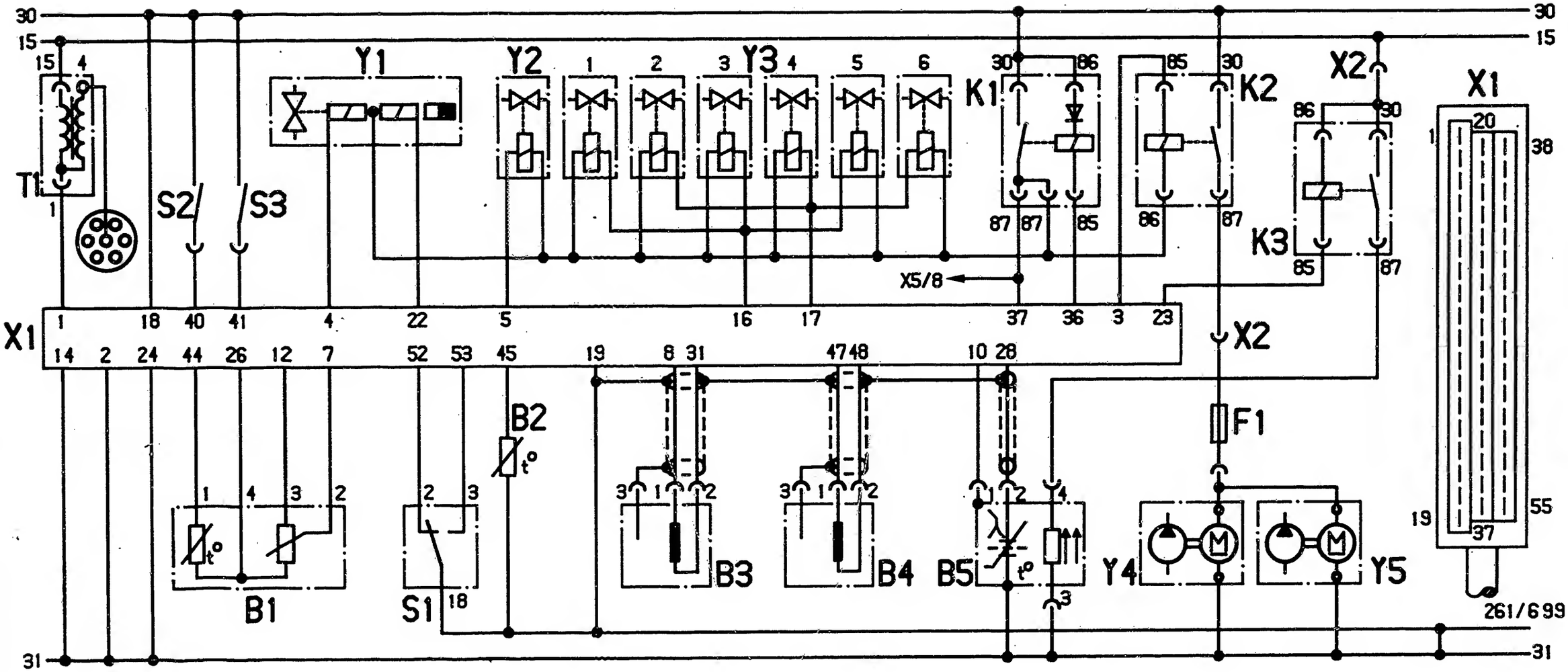
Vehicles with
catalytic converter: 0,7 ± 0,5 % CO by vol.
(measure CO upstream of the catalytic
converter if sampling pick-up fitted,
pull apart lambda-sensor plug).

See equipment and Autodata microcards for
the settings for valve clearance and other
engine-related data.

H17 — <==

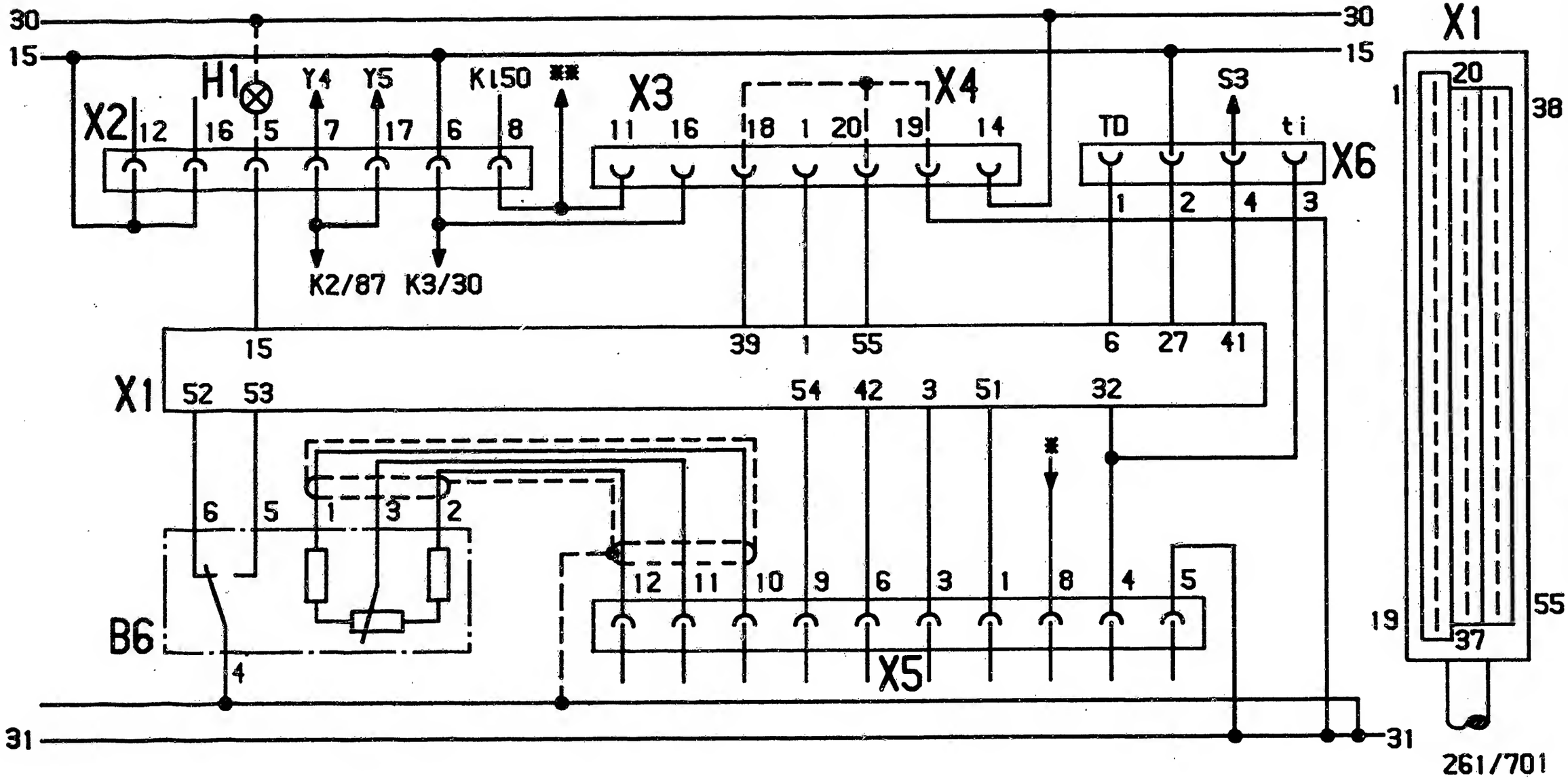
For production reasons:
continued on the following
coordinate.

H18 — => <=



ELECTRICAL TERMINAL DIAGRAM (3 and 5 Series)

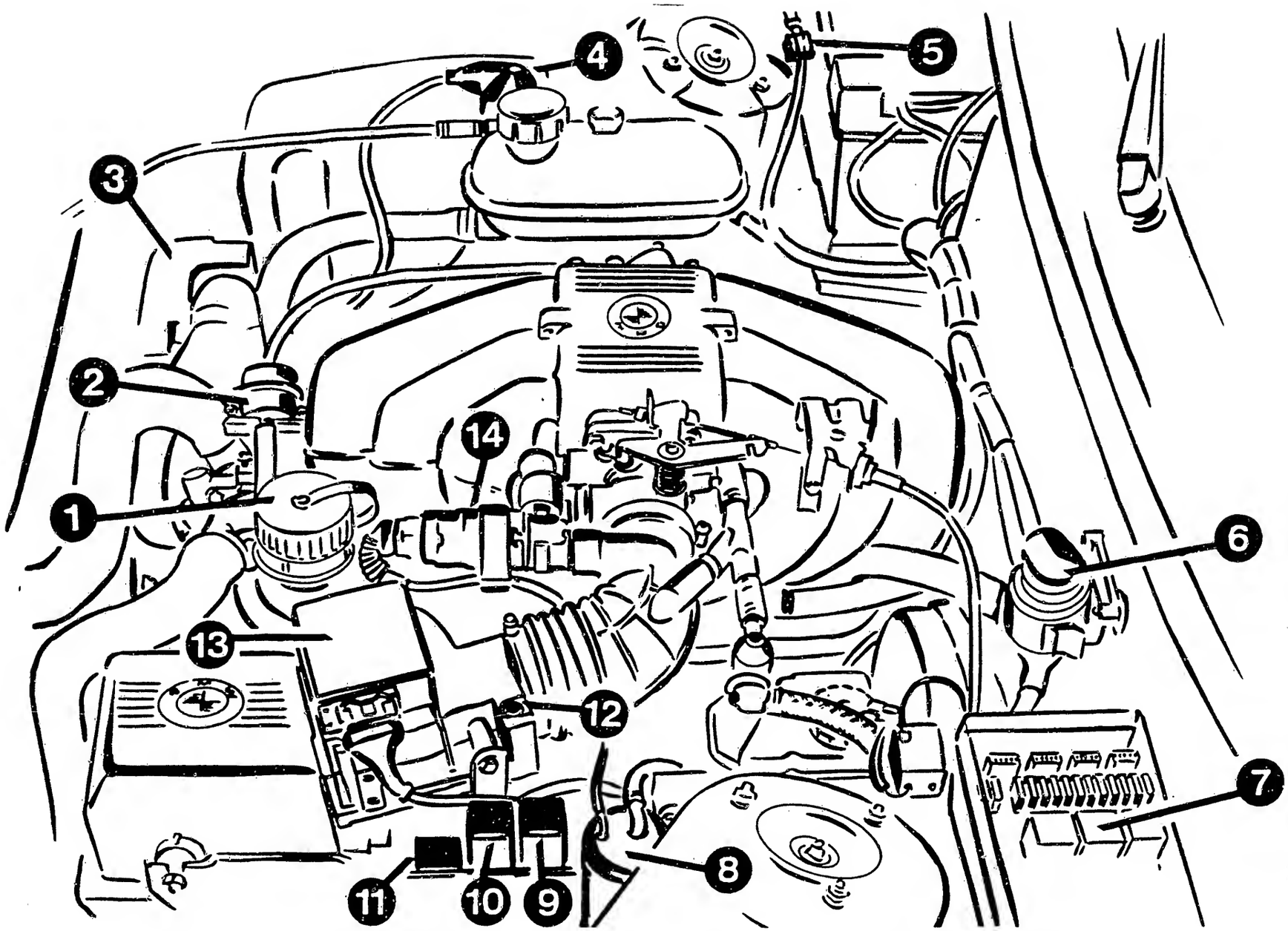
B1 = Air-flow sensor
B2 = Coolant-temperature sensor
B3 = High-voltage sensor
B4 = Eng.-speed/ref.-mark sensor
B5 = Heated lambda sensor (cat only)
F1 = Pump fuse
3 Series : No.11
5 Series : No.1
K1 = Main relay
K2 = Pump relay
K3 = Sensor-heater relay (cat only)
S1 = Throttle-valve switch
S2 = Switch on air-cond. compr.
S3 = Switch on air-conditioner
T1 = Ignition coil
X1 = Motronic control-unit plug
Y1 = Idle actuator
Y2 = Tank ventilation valve (cat only)
Y3 = Solenoid-operated injection valve
Y4 = Electric fuel pump
Y5 = Pre-supply pump (if present).



ELECTRICAL TERMINAL DIAGRAM (continued, 5 Series)

B6 = Throttle-valve switch with pot (with electro. transm. control for item S1)
H1 = "CARB" lamp (fault lamp; US version)
X1 = Motronic control-unit plug
X2 = Engine plug (20-pin)
X3 = Diagnostic plug (20-pin)
X4 = Jumper in diagnostic-plug cover
X5 = 13-pin plug to transmission control unit
X6 = 6-pin connector

* = from main relay term.87(+)
** = to starting motor term.50



261 / 702

INSTALLATION POSITION OF COMPONENTS (320i)

1 = Diagnostic socket
2 = Fuel-pressure regulator
3 = High-voltage distributor
4 = Ignition coil
5 = Motronic ground terminal
6 = Engine plug
7 = Fuse box
8 = Active carbon canister (cat only)
9 = Sensor-heater relay (color: orange)
10 = Pump relay (color: orange)
11 = Main relay (color: white)
12 = CO adjusting screw
13 = Air-flow sensor
14 = Idle actuator

INSTALLATION POSITION OF COMPONENTS (CONTINUED)

The installation locations always refer to the direction of travel.

Control unit:
In glove compartment above cover.

High-voltage sensor:
On high-tension ignition cable to cylinder 6.

Plug connection for high-voltage sensor:
Next to oil dipstick (top picture, Item 1)

Engine-speed/reference-mark sensor:
At front of engine, to right of crankshaft ring gear.

Plug connection for engine-speed/reference-mark sensor:
Next to oil dipstick (top picture, Item 2).

Lambda sensor:
In joint exhaust pipe (center picture, Item 1).

Plug connection for lambda sensor (round, 4-pole):
Beneath battery (center picture, Item 2).

Tank ventilation valve:
In engine compartment beneath throttle-valve assembly
(bottom picture, arrow).

Temperature sensor (air):
In air-flow sensor.

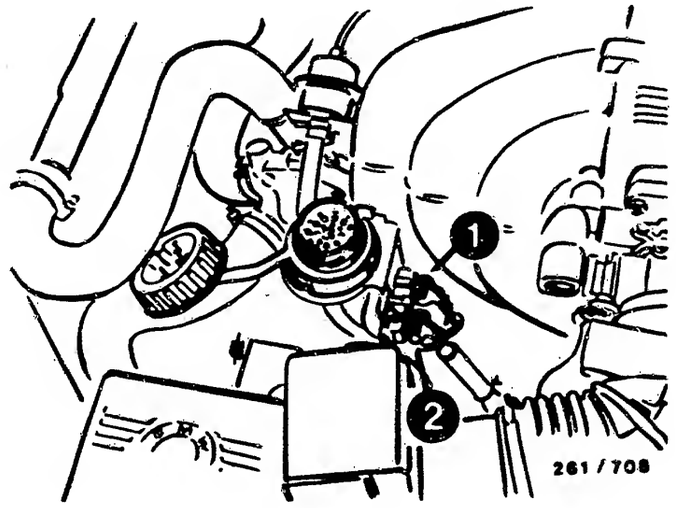
Electric fuel pump and fuel pressure damper:
Beneath vehicle on left.

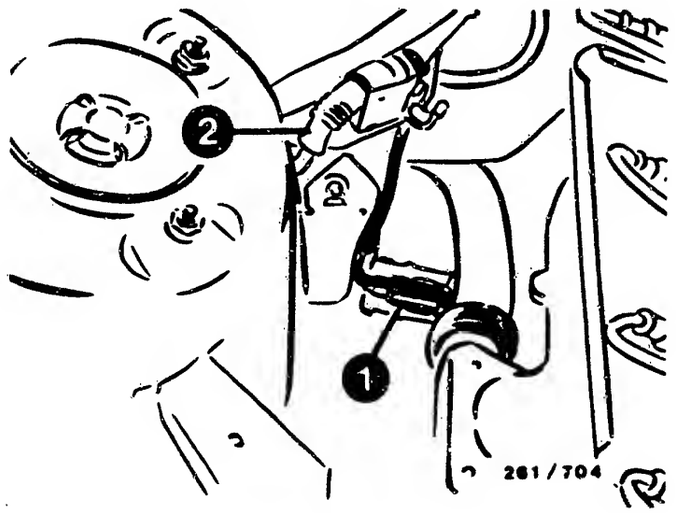
Fuse No. 11 for electric fuel pump:
In fuse box at bulkhead, left.

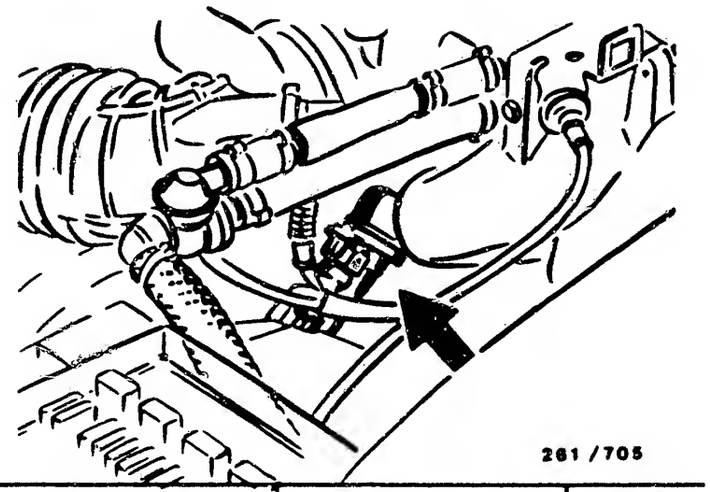
Fuel filter:
On left of engine compartment, next to bulkhead.

Temperature sensor (coolant)
Next to injection valve of cyl. 1.

Throttle-valve switch:
At bottom of throttle-valve assembly.







Trouble-shooting instructions : BMW-5010

BOSCH system : Motronic M1.1

Make of vehicle : BMW

Basic microcard : PKW-052

TABLE OF CONTENTS

SPECIAL FEATURES
These trouble-shooting instructions, valid at the time of publication, apply to the following vehicle models:

* BMW 535i with 3.5 l / 6 cyl. as of 12.86
  BMW M 535i with 3.5 l / 6 cyl. as of 1.87
  BMW 635 CSi with 3.5 l / 6 cyl. as of 1.87

* Motronic system M 1.1 with self-diagnosis and flashing-code output (55-pole plug).

* The fault memory can be read out using the Pocket System Tester KTS 300 (0 684 400 300) with the program module PPG 204 as of status 09.01.89.

  Note:
  Further diagnosis possibilities (actuator diagnosis etc), which would be feasible with newer program-module statuses, are not evaluated with these vehicles.

  Pay attention to operating instructions for KTS 300. Connection of the KTS 300 to the diagnosis socket in the vehicle is via the adapter lead 1 684 463 196 (BMW).

* As an alternative to the KTS 300, the self-diagnosis can be read out by way of a flashing code (not possible with all control units).

* The self-diagnosis test table takes account of both the KTS 300 and the flashing code and is arranged according to fault-code nos. indicated by the KTS 300.
  In some cases, the "fault indication" column includes two types of fault which can be optionally indicated by the tester, e.g.:
  Open-circuit/short-circuit to ground (= 1st type of fault)
  Short-circuit to positive (= 2nd type of fault)

SPECIAL FEATURES (CONTINUED)

* Control unit with variant encoding.
  Important note:
  Please refer to basic instructions for information which has to be given when ordering control unit.

* Group injection: Division into 2 groups which inject at different times (except in warm-up phase and on acceleration).
  Synchronization by means of sensor on ignition cable of cyl. 6.
  Group 1: Cylinders 1, 3, 5
  Group 2: Cylinders 2, 4, 6

* Joint sensor for engine speed and reference mark.

* Adaptive lambda closed-loop control and tank ventilation with pulsed valve (for cat.).

* Control unit with built-in hold circuit (for tank ventilation valve).

* Note on trouble-shooting:
  If vehicle computer and/or burglar alarm fitted, please note the following:
  If the code for depriming the system was entered incorrectly or if there is a defect in the vehicle computer/burglar alarm, positive is switched to term. 38 of the Motronic control unit.
  The engine can then not be started.
  For rapid testing, disconnect vehicle computer and alarm-system module and repeat attempted starting (no voltage at term. 38).

STRUCTURE AND USAGE

These brief instructions encompass essentially vehicle-specific special features and test specifications (set values).

In accordance with the customer complaint, the trouble-shooting chart leads to different causes/component faults.
For a detailed description of trouble-shooting, see the information in the trouble-shooting chart of the basic instructions.

ATTENTION: Even if reference is made to basic instructions, the set values, terminal assignments and special features of these vehicle-related brief instructions are always binding.

SAFETY AND PRECAUTIONARY MEASURES

In order to keep persons out of danger and to avoid damage to the engine, trigger boxes and control units or to the ignition system, observe the information in the basic instructions.

CAUTION!
High-performance ignition system with dangerous primary and secondary voltages!

Touching voltage-carrying components or terminals may prove fatal (both on the primary and secondary sides).

* Injection and high-voltage flashovers are to be avoided when testing compression.
  The main relay is therefore to be detached.

TROUBLE-SHOOTING CHART

Customer complaints (symptoms of trouble)

1. Starting motor operates, engine fails to start or starts only with difficulty.	2. Engine starts but but then dies.	3. Rough idling (engine speed, exhaust gas).	4. Poor throttle response, flat spot during acceleration.	5. Engine misfiring (ignition, fuel injection).	6. Maximum engine power/ top speed not reached.	7. Fuel consumption too high.	8. Engine running on (dieseling).	9. Engine pinging/knocking.	10. Engine overheating.	11. Fault lamp.	Cause (component fault)
*	*	*	*	*	*	*	*	*	*		Self-diagnosis
*											Voltage at control unit
*											Engine-speed/reference mark sensor
*		*			*	*					Fuel pressure
*		*				*	*				Solenoid-operated injection valves
		*	*		*						Throttle-valve switch
	*	*	*	*	*	*					Air-flow sensor
	*	*	*								Idle actuator
*	*	*	*								Air-intake system
		*									Idle speed, CO
*		*		*	*						Ignition coil
*		*	*	*	*						Primary signal
		*	*	*	*	*					Secondary pattern
*	*	*	*		*	*		*	*		Ignition point
*				*							High-voltage sensor
		*									Overrun cut-off
		*	*	*							Interference-suppression resistors
		*	*	*							Noise test
					*						Interference
					*						Throttle valve
					*						Fuel delivery
	*	*	*				*				Tank vent
		*	*								Lambda closed-loop control
*	*	*	*	*	*	*	*	*	*		Control unit

For production reasons: continued on the following coordinate.

SELF-DIAGNOSIS TEST TABLE

Pocket system tester Fault indication	Fault code	Flashing code	Test instructions/Test conditions	Terminals	Set values
Data exchange not possible	—	——	Prerequisite for fault output: Leads to diagnosis plug/fault lamp and power supply for control unit O.K.	13 55 15	——
Control unit Digital sec.(comput) defective	1	1211	Control unit defective.	——	——
Relay Fuel pump Op.circ/grnd short Short to B+	3	1261	Fault 1: Short-circuit to ground or open-circuit (op. circ). Fault 1 is only detected if other output stages are defective. Fault 2: Short-circuit to positive (Short to B+): Detach pump relay and measure voltage (with respect to ground) in frame (term. 86) with ignition on: Resistance of relay coil (term. 85/86): Test lead to control unit (term. 3).	3	10....15 V Approx. 50...150 Ω
Idle actuator ZWD winding 1/EWD Op.circ/grnd short Short to B+	4	1262	Fault code 4 points to current path from control unit term. 4 to idle actuator term. 3. Test leads and plug connection of actuator for open-circuit (op. circ), short-circuit to ground and short-circuit to positive (short to B+). Winding resistance of 1st winding at +15...+30°C between connections 3 and 2:	4	17... 23 Ω
Valve Tank ventilation Op.circ/grnd short Short to B+	5	1263	Only CAT models have tank ventilation valve. Test lead for contact with ground or positive Valve winding resistance at +15...+30°C: If lead and valve O.K., control unit is defective. Open-circuit (op. circ) is not detected!	5	35... 55 Ω
Air-flow sensor/ Air-mass sensor Signal too low Signal too high	7	1215	Signal too low: Test lead to term. 2 for short-circuit to ground. Open-circuit in leads to term. 2 and term. 3 or term. 4 and term. 3 jumpered. Signal too high: Test lead to term. 4 for open-circuit. Test leads to term. 4 and term. 2 for short-circuit to positive. Continued on next Coordinate.	7 12 26	——

SELF-DIAGNOSIS TEST TABLE (CONTINUED)

Pocket system tester Fault indication	Fault code	Flashing code	Test instructions/Test conditions	Terminals	Set values
Air-flow sensor/ Air-mass sensor			Basic tests: previous coordinates continued. Test resistances at air-flow sensor:		
Signal too low			between term. 2 and term. 4 (deflect sensor flap):		8...2500 Ω
			between term. 3 and term. 4:		500...1100 Ω
Signal too high			Measure wiper voltage at term. 2 with plug connected and ignition switched on: Sensor flap in off position:		0,2...0,3 V
			Slowly deflect sensor flap as far as full load:		Greater than 4,2 V
Lambda control			Test CO content (ahead of catalytic converter):	———	0,2...1,2 vol. %
outside min. range	10	1222	Test intake system for leaks. Test fuel pressure.		
outside max. range			Injection valves defective. Sensor defective.		
Fault lamp	15	———	Test lead to fault lamp (if provided) for short-circuit to ground and short circuit to positive (short to B+).	15	———
Op.circ/grnd short			Open-circuit (op. circ) is not detected!		
Short to B+					
Injectors (Group 2)	16	1252	Fault: Short-circuit to ground, to positive or open-circuit (op. circ) in joint positive/negative lead.	16	4,8...5,7 Ω (3 valves in parallel)
Op.circ/grnd short			Test injection valves of cyl. 1, 3, 5 for short-circuit/ open-circuit; if O.K., control unit is defective		14,5...17 Ω
Short to B+			Note: Open-circuits in individual injection valves are not detected.		(1 injection valve)
Injectors (Group 1)	17	1251	Fault: Short-circuit to ground, to positive or open-circuit (op. circ) in joint positive/ negative lead. Test injection valves of cyl. 2, 4, 6 for short-circuit/open-circuit; if O.K., control unit is defective	17	4,8...5,7 Ω (3 valves in parallel) 14,5...17 Ω
Op.circ/grnd short					
Short to B+			Note: Open-circuits in individual injection valves are not detected.		(1 injection valve)
Idle actuator ZWD Winding 2	22	1262	Fault code 22 points to current path from control unit term. 22 to idle actuator term. 1.	22	
Op.circ/grnd short			Test leads and plug connection of actuator for open-circuit (op. circ), short-circuit to ground and short-circuit to positive (short to B+).		
Short to B+			Winding resistance of 2nd winding at +15...+30°C between connections 1 and 2:		19...25 Ω

SELF-DIAGNOSIS TEST TABLE (CONTINUED)

Pocket system tester Fault indication	Fault code	Flashing code	Test instructions/Test conditions	Terminals	Set values
Lambda sensor Open circuit Ground short Short to B+	28	1221	Test lead for open-circuit, short-circuit to ground and short-circuit to positive (short to B+). Watch out for worn cable insulation! Sensor heater defective. Sensor clogged.	28	———
Speed signal incorrect/no signal	29	——	Test lead for open-circuit, short-circuit to ground and short-circuit to positive. If leads and plug connections are O.K., continue trouble-shooting in instrument cluster.	29	———
Battery voltage too low too high	37	1231	Supply voltage for control unit too low: Test voltage dips at positive and ground terminal. Charge battery. Supply voltage for control unit too high: Test alternator regulator.	37 19 (+) (-)	Greater than 10 V (with engine running) Less than 16 V (with engine running)
ASR/MSR interface Short to B+	38	——	Test lead to vehicle computer/burglar alarm for short-circuit to positive (short to B+). If lead and plug connections are O.K., continue trouble-shooting in vehicle computer or in burglar alarm.	38	———
Air cond. readiness/AC compr. sign. Comparison not O.K.	40	——	Test lead from control unit term. 40 to A/C compressor for short-circuit to positive. Test lead from control unit term. 41 to A/C switch (A/C readiness) for open-circuit.	40 41	———
Air-temp. sensor Op. circ./sh. to B+ Short to ground	44	1224	Test temperature sensor and lead for open-circuit (op. circ.), short-circuit to ground (short to ground) and short-circuit to positive (short to B+). Temperature-sensor resistance: at +15...+30°C:	44	1450...3300 Ω
Engine temp. sensor Op. circ./sh. to B+ Short to ground	45	1223	Test temperature sensor and lead for open-circuit (op. circ.), short-circuit to ground (short to ground) and short-circuit to positive (sh. to B+). Temperature-sensor resistance: at +15...+30°C: at approx. +80°C:	45	1450...3300 Ω 280... 360 Ω
Transmission identification Short to ground	51	1278	Applies to electronic transmission control (GS): Test lead for short-circuit to ground (short to ground) or corresponding output in transmission control unit defective. Term. 51 is open on vehicles without GS.	51	———

SELF-DIAGNOSIS TEST TALE (CONTINUED)

Pocket system tester Fault indication	Fault code	Flashing code	Test instructions/Test conditions	Terminals	Set values
Idle switch Short to ground	52	1232	Fault: Idle contact (in throttle-valve switch) permanently closed or short-circuit to ground (short to ground) in lead. Idle contact closed in off position: Actuate throttle valve somewhat:	52	 Approx. 0 Ω Infinity Ω
Full-load switch Short to ground	53	1233	Fault: Full-load contact (in throttle-valve switch) permanently closed or short-circuit to ground (short to ground) in lead. Full-load contact closed in full-throttle position: Release accelerator pedal somewhat:	53	 Approx. 0 Ω Infinity Ω
Converter clutch/ Driving pos. switch Comparison not O.K.	54 (24)	——	Note: Fault code 24 corresponds to fault code 54 Applies to electronic transmission control (GS): Test lead from control unit term. 54 for short-circuit to ground. If lead O.K., continue trouble-shooting in electronic transmission control. Term. 54 is open on vehicles without GS.	54	——
CU output stages with fin.cntling el. defective	100	——	CU = Control unit. Test following components and leads for open-circuit, short-circuit to ground and short-circuit to positive: Idle actuator, injection valves, fuel pump relay, tank ventilation valve and fault lamp if fitted.	4 22 16 17 3 5 15	——
No fault stored		4444 or 1444	Continue trouble-shooting with trouble-shooting chart.	——	——

Pressure regulator	
Fuel pressure	2,8...3,2 bar
Electric fuel pump	
Delivery (measured in return)	at least 950 cm ^{3} /30s
Supply voltage (under load):	at least 12 V
Temperature sensor (intake air)	
Internal electrical resistance measured in air-flow sensor between term. 1 and term. 4 at ambient temperature (+15°C...+30°C):	1450...3300 Ω
Temperature sensor (engine)	
Color of plug, blue. Internal electrical resistance at ambient temperature (+ 15° C...+ 30° C):	1450...3300 Ω
with engine at normal operating temperature (approx. +80°C):	280...360 Ω
Solenoid-operated injection valve	
Internal electrical resistance at ambient temperature (+ 15° C...+ 30° C):	14,5...17 Ω
Air-flow sensor	
Internal electrical resistance between:	
term. 2 and term. 4:	8...2500 Ω (*)
term. 3 and term. 4:	500...1100 Ω

(*) Slowly deflect the sensor flap as far as it will go. Fluctuating increase in resistance with slight decrease towards end.

Engine-speed and reference-mark sensor		
Internal electrical resistance between term. 1 and term. 2 at ambient temperature (+15°C...+30°C):		400...800 Ω
Air gap:		0,8 ± 0,5 mm
Throttle-valve switch		
Resistance value of idle contact (term. 2 and term. 18):		0 Ω
Resistance value of full-load contact (term. 3 and term. 18):		0 Ω
Idle actuator		
Internal electrical resistance at +15°...+30°C between		
term. 1 and term. 2:		19...25 Ω
term. 3 and term. 2:		17...22,5 Ω
Lambda sensor		
Resistance value of heater winding:		1...15 Ω
Ignition coil		
Primary resistance:	approx.	0 Ω
Secondary resistance:		5000...7200 Ω
Interference-suppression resistors		
High-voltage-distributor rotor:		1 k Ω
High-voltage-distributor dome:	each	1 k Ω
Spark-plug connector:	each	5 k Ω
Spark plugs:		5 k Ω
Ignition coil:		1 k Ω

TEST SPECIFICATIONS (CONTINUED)

High-voltage sensor:
Internal electrical resistance
between term. 1 and term. 2: approx. 0 Ω

Tank-ventilation valve:
(only in vehicles with catalytic converter)
Internal electrical resistance at
ambient temperature (+15°C...+30°C): 35...55 Ω

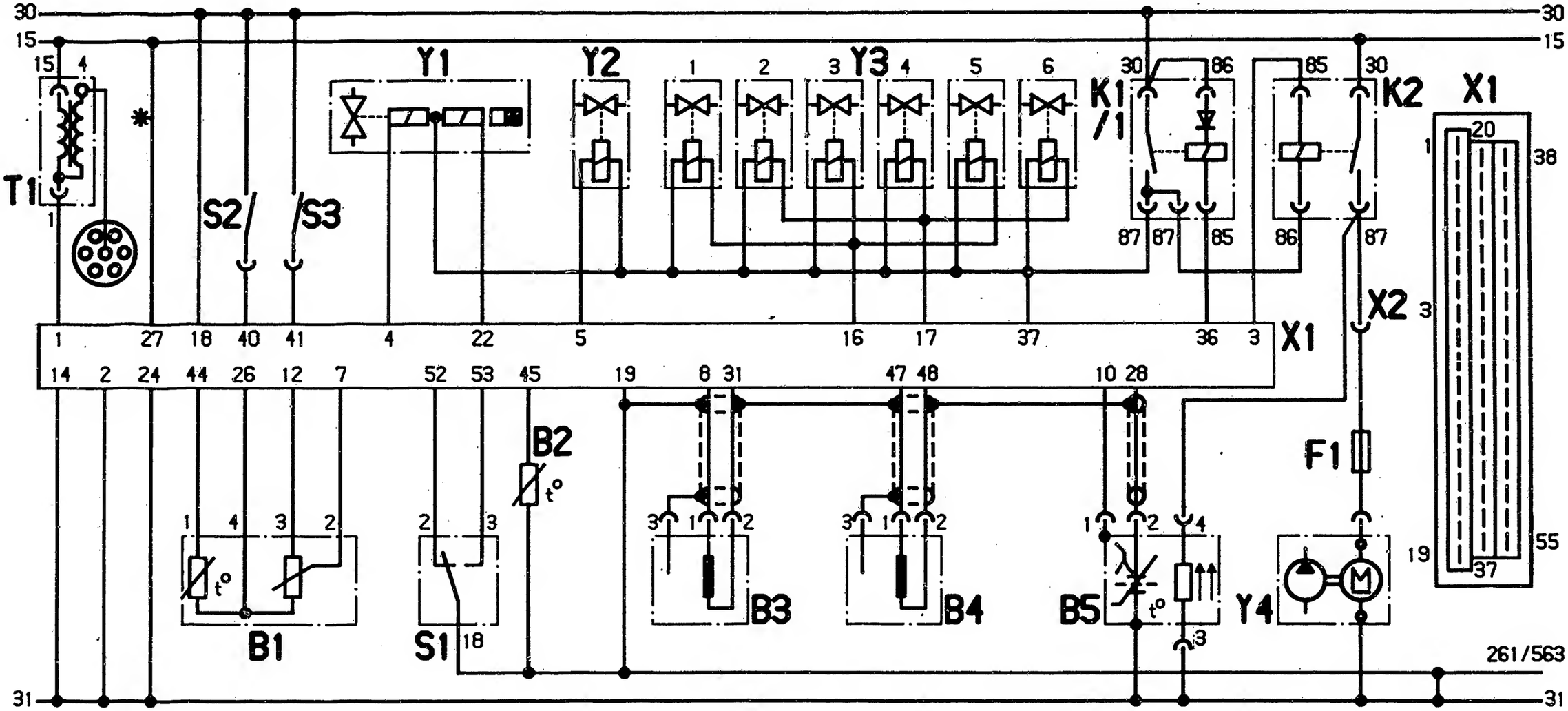
Idle test:
Engine at normal operating temperature,
switch off loads.
Idle speed: 800 ± 40 min $^{-1}$
Spark-advance angle: 10° ± 5°°
crankshaft
(Automatic transmission to N or P)

CO content: without
catalytic converter: 0,5...1,5 % CO by vol.
Adjust mixture at the bypass screw
in the air-flow sensor:
turning to the left makes mixture leaner,
turning to the right makes mixture richer.

Vehicles with
catalytic converter: 0,2...1,2 % CO by vol.
(measure CO upstream of the catalytic
converter if sampling pick-up fitted,
pull apart lambda-sensor plug).

For production reasons:
continued on the following
coordinate.

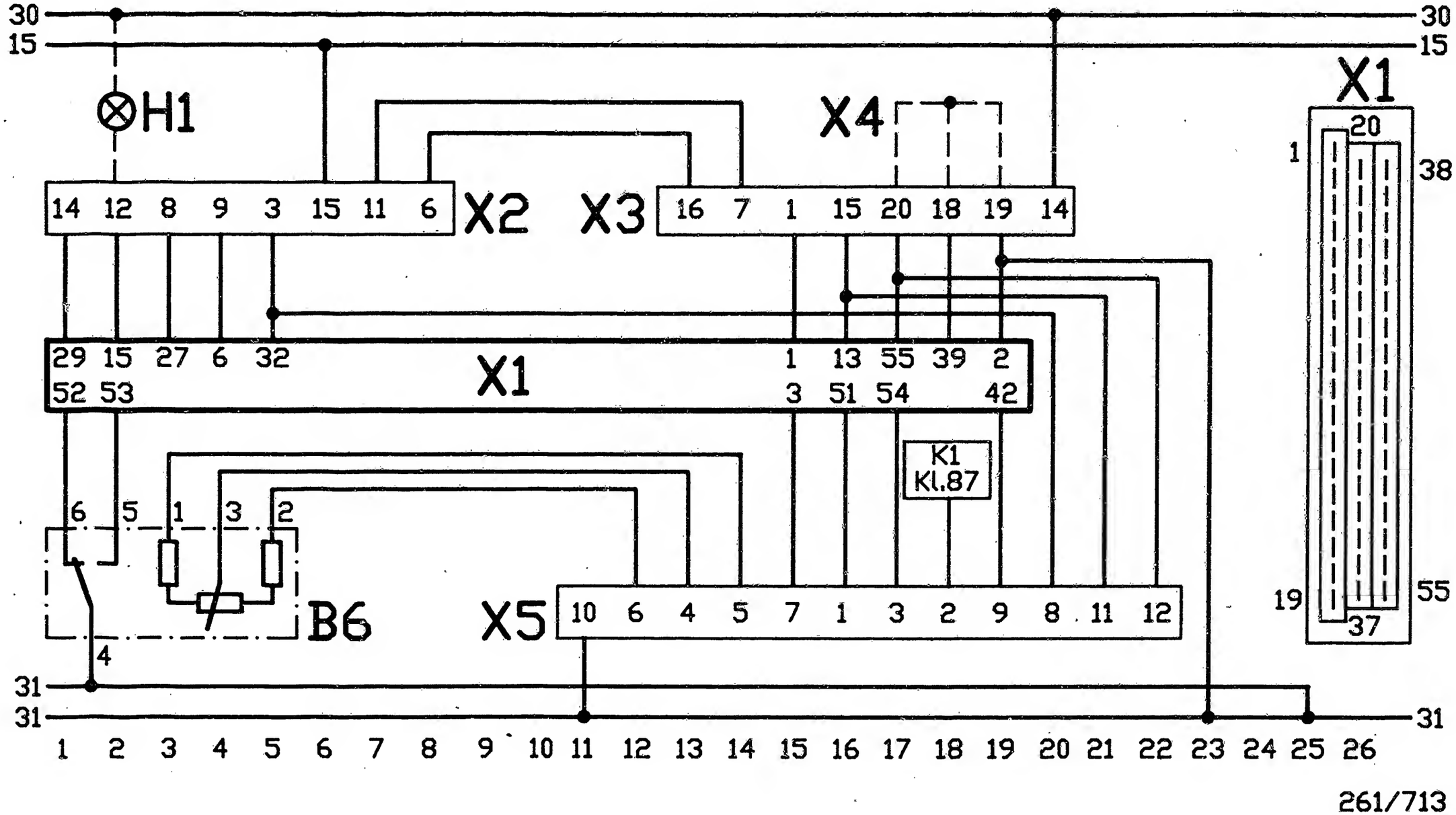
See equipment and Autodata microcards for
the settings for valve clearance and other
engine-related data.



ELECTRICAL TERMINAL DIAGRAM (5 and 6 Series)

B1 = Air-flow sensor
B2 = Engine-temperature sensor
B3 = High-voltage sensor
B4 = Engine-speed/reference-mark sensor
B5 = Heated lambda sensor (Cat only)
F1 = Pump fuse
K1/1 = Main relay (circuitry as of 12.86)
K2 = Pump relay
S1 = Throttle-valve switch
S2 = Switch on air-conditioner compressor
S3 = Switch on air conditioner
T1 = Ignition coil
X1 = Motronic control-unit plug
Y1 = Idle actuator
Y2 = Tank-ventilation valve (Cat only)
Y3 = Solenoid-operated injection valve
Y4 = Electric fuel pump

*) = Lead as of FD 652

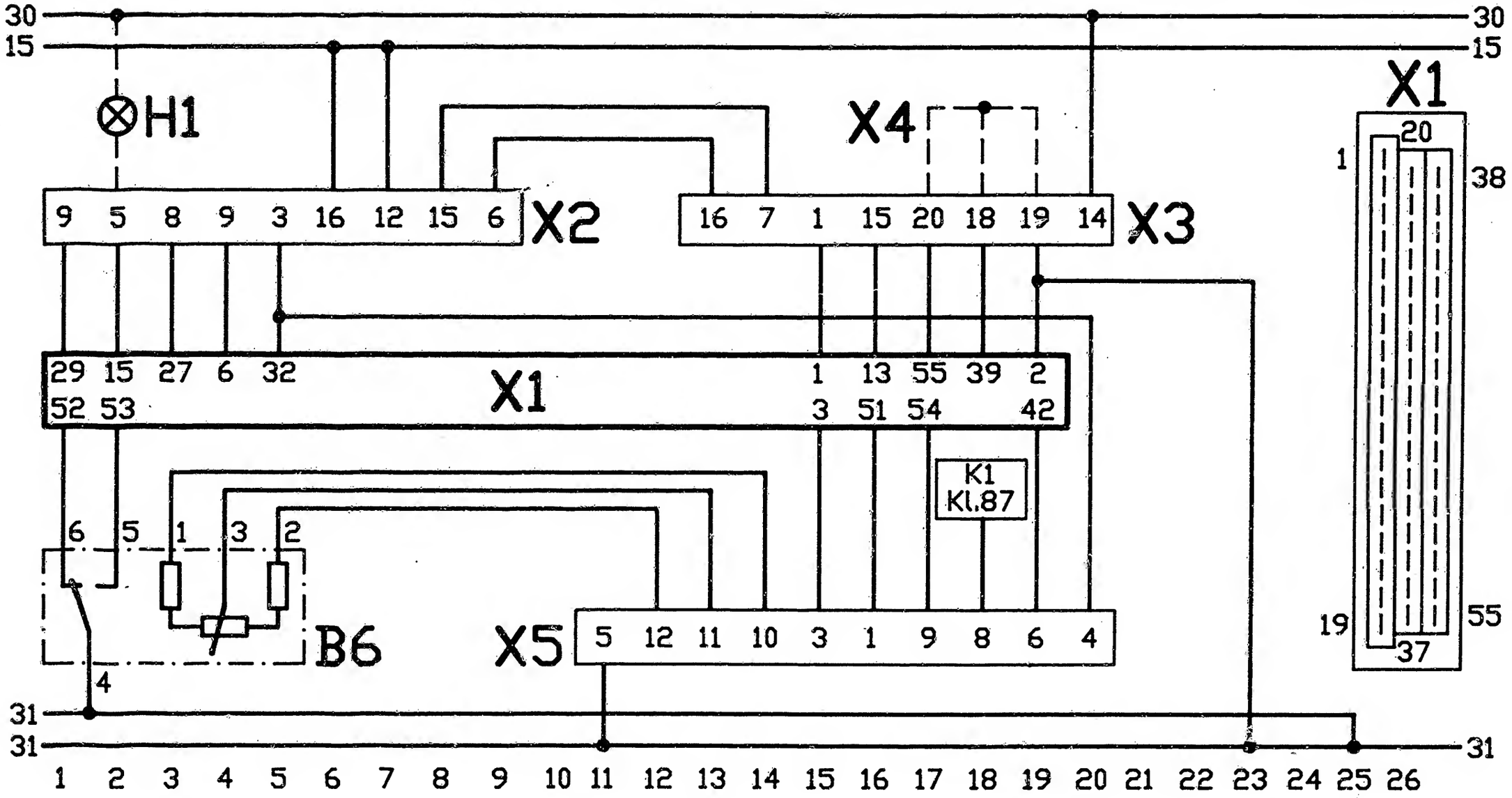


ELECTRICAL TERMINAL DIAGRAM (continued, 6 Series)

B6 = Throttle-valve switch with pot
(on electron. transmission control for Item S1)
H1 = "CARB" lamp (fault lamp; US version)
X1 = Motronic control-unit plug
X2 = Engine plug
X3 = Diagnostic plug
X4 = Bridge in diagnostic-plug cover
X5 = Plug to transmission control unit

J21 — ⟺

J22 — ⟺

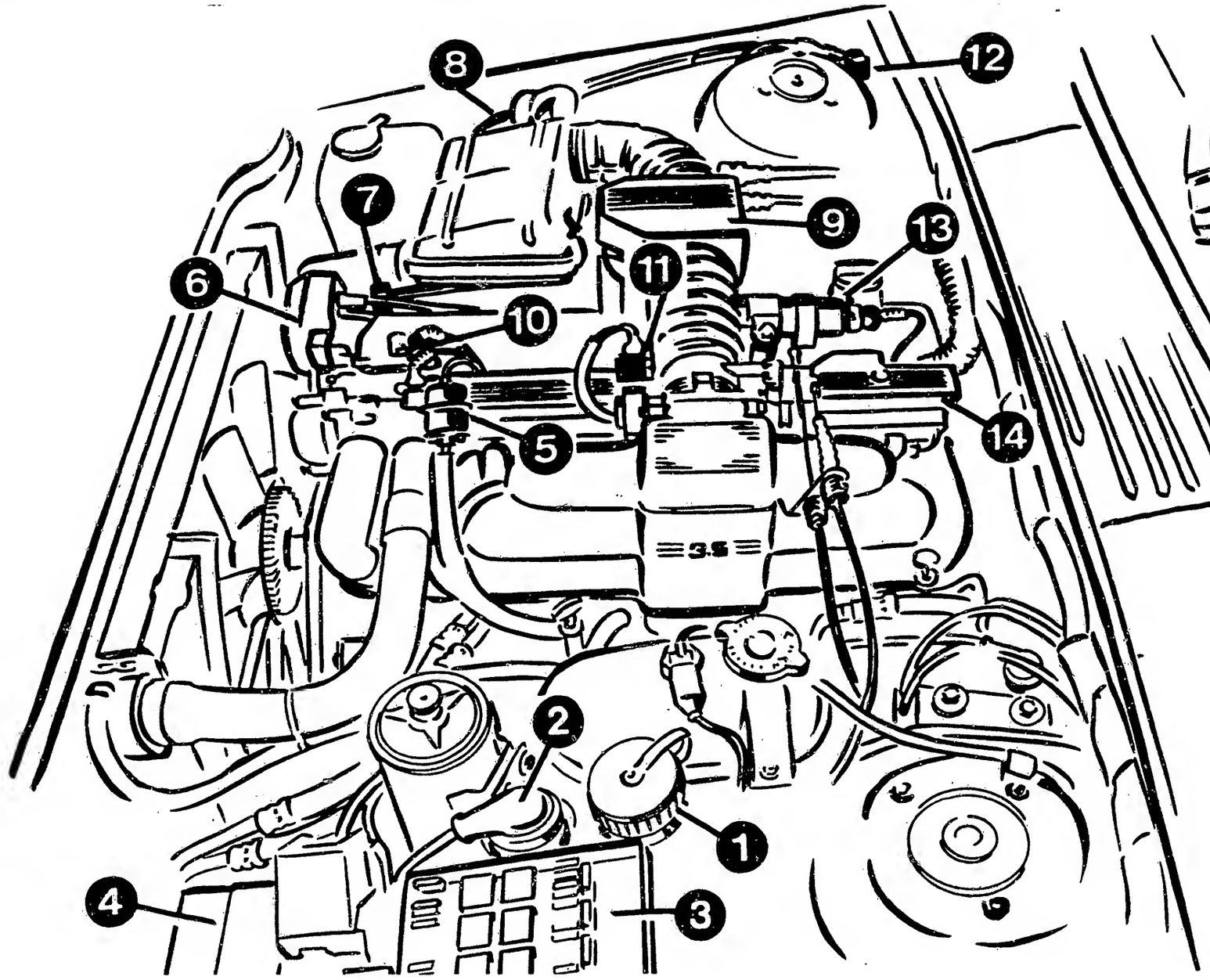


ELECTRICAL TERMINAL DIAGRAM (Continued, 5 Series)

B6 = Throttle-valve switch with pot
(on electron. transmission control for Item S1)
H1 = "CARB" lamp (fault lamp; US Version)
X1 = Motronic control-unit plug
X2 = Engine plug
X3 = Diagnostic plug
X4 = Bridge in diagnostic-plug cover
X5 = Plug to transmission control unit

J23 — <==>

J24 — <==



261 / 715

1 = Diagnostic socket
2 = Engine plug
3 = Fuse box
4 = Battery
5 = Fuel-pressure regulator
6 = High-voltage distributor
7 = High-voltage sensor
8 = Ignition coil
9 = Air-flow sensor
10 = Coolant-temperature sensor
11 = Throttle-valve switch
12 = Ground terminal
13 = Idle actuator
14 = Cover over the injection valves

INSTALLATION POSITION OF COMPONENTS

Note: The illustration shows the BMW 635 CSi. The installation positions in the BMW 535 i and M 535 i are similar.

The high-voltage sensor is pushed on to the H.T. lead of cylinder 6, see upper illustration, Item 1.

The engine-speed/reference-mark sensor is located on the engine at the front, to the right of the crankshaft ring gear, see upper ill., Item 2 .

Plug-in connection of the engine-speed/reference-mark sensor:
On the fuel-distribution pipe, center illustration, Item 1.

Plug-in connection of the high-voltage sensor:
On the fuel-distribution pipe, centre illustration 2.

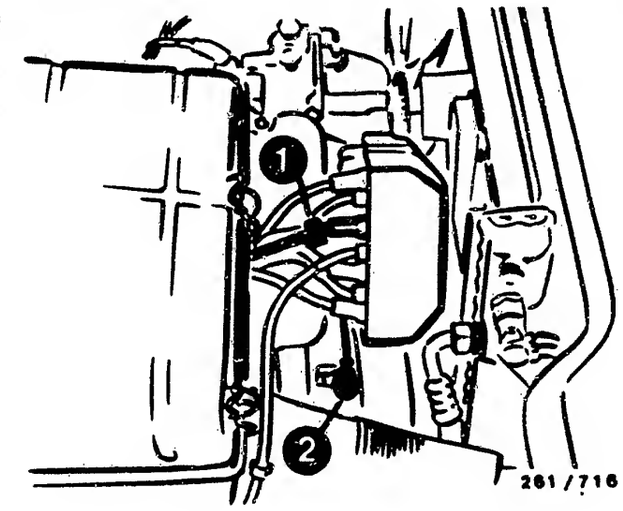
Lower illustration:
The fuel-pump relay, Item 1, (color: orange) and the main relay Item 2 (color: white) are located beneath a cover on the fuse box.
The fuse No. 11 for the electric fuel pump is located in the fuse box (lower illustration, Item 3).

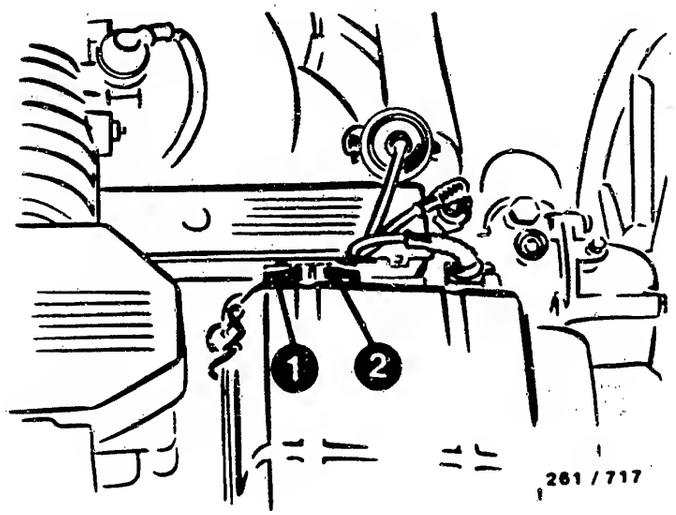
The Motronic control unit is located in the glove compartment above a plastic cover.

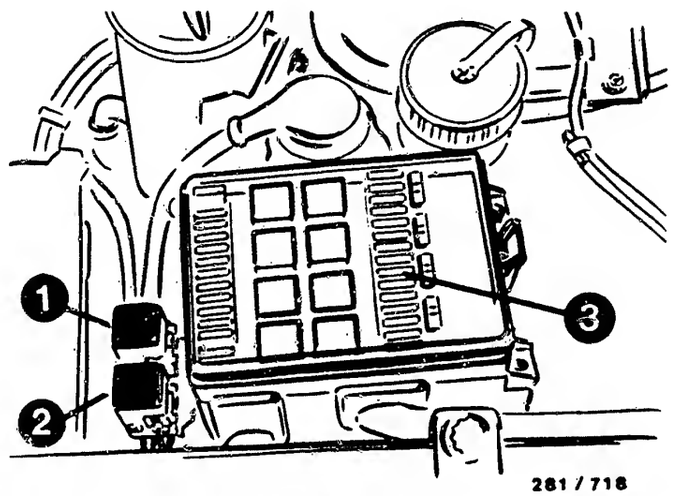
Lambda sensor: in the common exhaust pipe.

Tank-ventilation valve (only in vehicles with catalytic converter): beneath the throttle-valve assembly.

Fuel filter and electric fuel pump:
Beneath the vehicle, on the right-hand side as seen in the forward direction of travel, in front of the tank
Air-intake temperature sensor and CO adjusting screw:
In the air-flow sensor.







Trouble-shooting instructions	:	BMW-5024
BOSCH system	:	Motronic M 1.3
Make of vehicle	:	BMW
Basic microcard	:	PKW-052

TABLE OF CONTENTS

SPECIAL FEATURES

These trouble-shooting instructions, valid at the time of publication, apply to the following vehicle models:

*BMW 530i with and without catalytic converter as of 02.88
Engine: 3.0 l / 6 cyl.
*BMW 535i with and without catalytic converter as of 02.88
Engine: 3.5 l / 6 cyl.

* Motronic system M 1.3 with self-diagnosis and flashing-code output (55-pole plug).

* The fault memory can be read out using the Pocket System Tester KTS 300 (0 684 400 300) with the program module PPG 204 as of status 09.01.89.

Note:
Further diagnosis possibilities (actuator diagnosis etc), which would be feasible with newer program-module statuses, are not evaluated with these vehicles.

Pay attention to operating instructions for KTS 300.
Connection of the KTS 300 to the diagnosis socket in the vehicle is via the adapter lead 1 684 463 196 (BMW).

* As an alternative to the KTS 300, the self-diagnosis can be read out by way of a flashing code (not possible with all control units).

* The self-diagnosis test table takes account of both the KTS 300 and the flashing code and is arranged according to fault-code nos. indicated by the KTS 300. In some cases, the "fault indication" column includes two types of fault which can be optionally indicated by the tester, e.g:
Short-circuit to ground (= 1st type of fault)
Short-circuit to positive (= 2nd type of fault)

SPECIAL FEATURES (CONTINUED)

* Initiation (stimulation) and continuation of the flashing-code fault output are effected by pressing the full-load switch 5 times (accelerate to full throttle 5 times within 5 seconds with ignition switched on).
  Every flashing code is continuously output until continuation is effected.
  As a last step, the flashing code 0 0 0 0 or 1 0 0 0 appears = end of output.
  The fault memory is cleared by closing the full-load switch for at least 10 seconds during output of the flashing code "end of output".
  Termination of self-diagnosis: Switch off ignition.

* Control unit with variant encoding.
  Important:
  Please refer to basic instructions for information which has to be given when ordering control unit.

* Group injection: Division into 2 groups which inject at different times (except during warm-up phase and on acceleration).
  Synchronization by way of sensor on ignition cable of cyl. 6.
  Group 1: Cylinders 1,3,5
  Group 2: Cylinders 2,4,6

* Adaptive lambda closed-loop control and tank ventilation with pulsed valve (for cat.).

* Note on trouble-shooting:
  If vehicle computer and/or burglar alarm fitted, attention is to be paid to the following:
  If the code for depriming the system was entered incorrectly or if there is a defect in the vehicle computer/burglar alarm, positive is switched to term. 38 of the Motronic control unit.
  The engine cannot be started.
  For rapid testing, disconnect vehicle computer and alarm-system module and repeat attempted starting (no voltage at term. 38).

STRUCTURE AND USAGE

These brief instructions encompass essentially vehicle-specific special features and test specifications (set values).

In accordance with the customer complaint, the trouble-shooting chart leads to different causes/component faults.
For a detailed description of trouble-shooting, see the information in the trouble-shooting chart of the basic instructions.

ATTENTION: Even if reference is made to basic instructions, the set values, terminal assignments and special features of these vehicle-related brief instructions are always binding.

SAFETY AND PRECAUTIONARY MEASURES

In order to keep persons out of danger and to avoid damage to the engine, trigger boxes and control units or to the ignition system, observe the information in the basic instructions.

CAUTION!
High-performance ignition system with dangerous primary and secondary voltages!

Touching voltage-carrying components or terminals may prove fatal (both on the primary and secondary sides).

* Avoid injection of fuel and high-voltage flashovers when testing the compression.
  Therefore, disconnect Motronic relay.

TROUBLE-SHOOTING CHART

Customer complaints (symptoms of trouble)

1. Starting motor operates, engine fails to start or starts only with difficulty.	2. Engine starts but but then dies.	3. Rough idling (engine speed, exhaust gas).	4. Poor throttle response, flat spot during acceleration.	5. Engine misfiring (ignition, fuel injection).	6. Maximum engine power/ top speed not reached.	7. Fuel consumption too high.	8. Engine running on (dieseling).	9. Engine pinging/knocking.	10. Engine overheating.	11. Fault lamp.	Cause (component fault)
*	*	*	*	*	*	*	*	*	*		Self-diagnosis
*											Voltage at control unit
*											Engine-speed/reference mark sensor
*		*			*	*					Fuel pressure
*		*				*	*				Solenoid-operated injection valves
		*	*		*						Throttle-valve switch
	*	*	*	*	*	*					Air-flow sensor
	*	*	*								Idle actuator
*	*	*	*								Air-intake system
		*									Idle speed, CO
*		*		*	*						Ignition coil
*		*	*	*	*						Primary signal
		*	*	*	*	*					Secondary pattern
*	*	*	*		*	*		*	*		Ignition point
*				*							High-voltage sensor
		*									Overrun cut-off
		*	*	*							Interference-suppression resistors
		*	*	*							Noise test
					*						Interference
					*						Throttle valve
					*						Fuel delivery
	*	*	*				*				Tank vent
		*	*								Lambda closed-loop control
*	*	*	*	*	*	*	*	*	*		Control unit

K05 —— => <=

For production reasons: continued on the following coordinate.

K06 —— => <=

SELF-DIAGNOSIS TEST TABLE

Pocket system tester Fault indication	Fault code	Flashing code	Test instructions/Test conditions	Terminals	Set values
Data exchange not possible	—	——	Prerequisite for fault output: Leads to diagnosis plug/fault lamp and power supply for control unit O.K.	13 55 15	——
Control unit Digital sec.(comput) defective	1	1211	Control unit defective.	——	——
Relay Fuel pump Op.circ/grnd short Short to B+	3	1261	Fault 1: Short-circuit to ground or open-circuit (op. circ). Fault 1 is only detected if other output stages are defective. Fault 2: Short-circuit to positive (Short to B+): Detach pump relay and measure voltage (with respect to ground) in frame (term. 86) with ignition on: Resistance of relay coil (term. 85/86): Test lead to control unit (term. 3).	3	10....15 V Approx. 50...150 Ω
Idle actuator ZWD winding 1/EWD Op.circ/grnd short Short to B+	4	1262	Fault code 4 points to current path from control unit term. 4 to idle actuator term. 3. Test leads and plug connection of actuator for open-circuit (op. circ), short-circuit to ground and short-circuit to positive (short to B+). Winding resistance of 1st winding at +15...+30°C between connections 3 and 2:	4	17...23 Ω
Valve Tank ventilation Op.circ/grnd short Short to B+	5	1263	Only CAT models have tank ventilation valve. Test lead for contact with ground or positive Valve winding resistance at +15...+30°C: If lead and valve O.K., control unit is defective. Open-circuit (op. circ) is not detected!	5	35...55 Ω
Air-flow sensor/ Air-mass sensor Signal too low Signal too high	7	1215	Signal too low: Test lead to term. 2 for short-circuit to ground. Open-circuit in leads to term. 2 and term. 3 or term. 4 and term. 3 jumpered. Signal too high: Test lead to term. 4 for open-circuit. Test leads to term. 4 and term. 2 for short-circuit to positive. Continued on next Coordinate.	7 12 26	——

SELF-DIAGNOSIS TEST TABLE (CONTINUED)

Pocket system tester Fault indication	Fault code	Flashing code	Test instructions/Test conditions	Terminals	Set values
Air-flow sensor/ Air-mass sensor Signal too low Signal too high			Basic tests: previous coordinates continued. Test resistances at air-flow sensor: between term. 2 and term. 4 (deflect sensor flap): between term. 3 and term. 4: Measure wiper voltage at term. 2 with plug connected and ignition switched on: Sensor flap in off position: Slowly deflect sensor flap as far as full load:		 8...2500 Ω 500...1100 Ω 0,2... 0,3 V Greater than 4,2 V
Lambda control outside min. range outside max. range	10	1222	Test CO content (ahead of catalytic converter): Test intake system for leaks. Test fuel pressure. Injection valves defective. Sensor defective.	———	0,2... 1,2 vol. %
Fault lamp Op.circ/grnd short Short to B+	15	———	Test lead to fault lamp (if provided) for short-circuit to ground and short circuit to positive (short to B+). Open-circuit (op. circ) is not detected!	15	———
Injectors (Group 2) Op.circ/grnd short Short to B+	16	1252	Fault: Short-circuit to ground, to positive or open-circuit (op. circ) in joint positive/negative lead. Test injection valves of cyl. 1, 3, 5 for short-circuit/open-circuit; if O.K., control unit is defective Note: Open-circuits in individual injection valves are not detected.	16	4,8... 5,7 Ω (3 valves in parallel) 14,5... 17 Ω (1 injection valve)
Injectors (Group 1) Op.circ/grnd short Short to B+	17	1251	Fault: Short-circuit to ground, to positive or open-circuit (op. circ) in joint positive/negative lead. Test injection valves of cyl. 2, 4, 6 for short-circuit/open-circuit; if O.K., control unit is defective Note: Open-circuits in individual injection valves are not detected.	17	4,8... 5,7 Ω (3 valves in parallel) 14,5... 17 Ω (1 injection valve)
Idle actuator ZWD Winding 2 Op.circ/grnd short Short to B+	22	1262	Fault code 22 points to current path from control unit term. 22 to idle actuator term. 1. Test leads and plug connection of actuator for open-circuit (op. circ), short-circuit to ground and short-circuit to positive (short to B+). Winding resistance of 2nd winding at +15...+30°C between connections 1 and 2:	22	 19... 25 Ω

SELF-DIAGNOSIS TEST TABLE (CONTINUED)

Pocket system tester Fault indication	Fault code	Flashing code	Test instructions/Test conditions	Terminals	Set values
Lambda sensor Open circuit Ground short Short to B+	28	1221	Test lead for open-circuit, short-circuit to ground and short-circuit to positive (short to B+). Watch out for worn cable insulation! Sensor heater defective. Sensor clogged.	28	———
Speed signal incorrect/no signal	29	———	Test lead for open-circuit, short-circuit to ground and short-circuit to positive. If leads and plug connections are O.K., continue trouble-shooting in instrument cluster.	29	———
Battery voltage too low too high	37	1231	Supply voltage for control unit too low: Test voltage dips at positive and ground terminal. Charge battery. Supply voltage for control unit too high: Test alternator regulator.	18 19 (+) (-)	Greater than 9 V (with engine running) Less than 16 V (with engine running)
ASR/MSR interface Short to B+	38	———	Test lead to vehicle computer/burglar alarm for short-circuit to positive (short to B+). If lead and plug connection are O.K., continue trouble-shooting in vehicle computer/burglar alarm.	38	———
Air cond. readiness/AC comp. sign. Comparison not O.K.	40	———	Test lead from control unit term. 40 to A/C compressor for short-circuit to positive. Test lead from control unit term. 41 to A/C switch (A/C readiness) for open-circuit.	40 41	———
Air-temp. sensor Op.circ./sh. to B+ Short to ground	44	1224	Test temperature sensor and lead for open-circuit (op. circ.), short-circuit to ground (short to ground) and short-circuit to positive (sh. to B+). Temperature-sensor resistance: at +15...+30°C:	44	1450...3300 Ω
Engine temp. sensor Op. circ./sh. to B+ Short to ground	45	1223	Test temperature sensor and lead for open-circuit (op. circ.), short-circuit to ground (short to ground) and short-circuit to positive (short to B+). Temperature-sensor resistance: at +15...+30°C: at approx. +80°C:	45	1450...3300 Ω 280... 360 Ω
Transmission identification Short to ground	51	1278	Applies to electronic transmission control (GS): Test lead for short-circuit to ground (short to ground) or corresponding output in transmission control unit defective. Term. 51 is open on vehicles without GS.	51	———

SELF-DIAGNOSIS TEST TALE (CONTINUED)

Pocket system tester Fault indication	Fault code	Flashing code	Test instructions/Test conditions	Terminals	Set values
Idle switch Short to ground	52	1232	Fault: Idle contact (in throttle-valve switch) permanently closed or short-circuit to ground (short to ground) in lead. Idle contact closed in off position: Actuate throttle valve somewhat:	52	 Approx. 0 Ω Infinity Ω
Full-load switch Short to ground	53	1233	Fault: Full-load contact (in throttle-valve switch) permanently closed or short-circuit to ground (short to ground) in lead. Full-load contact closed in full-throttle position: Release accelerator pedal somewhat:	53	 Approx. 0 Ω Infinity Ω
Converter clutch/ Driving pos. switch Comparison not O.K.	54 (24)	——	Note: Fault code 24 corresponds to fault code 54 Applies to electronic transmission control (GS): Test lead from control unit term. 54 for short-circuit to ground. If lead O.K., continue trouble-shooting in electronic transmission control. Term. 54 is open on vehicles without GS.	54	——
CU output stages with fin.cntling el. defective	100	——	CU = Control unit. Test following components and leads for open-circuit, short-circuit to ground and short-circuit to positive: Idle actuator, injection valves, fuel pump relay, tank ventilation valve and fault lamp if fitted.	4 22 16 17 3 5 15	——
No fault stored		4444 or 1444	Continue trouble-shooting with trouble-shooting chart.	——	——

Pressure regulator	
Fuel pressure	3,0 l: 2,8...3,2 bar
	3,5 l: 2,8...3,2 bar
Electric fuel pump	
Delivery (measured in return):	min. 950 cm ^{3} /30s
Supply voltage (under load):	min. 12 V
Temperature sensor (air)	
Internal resistance measured at air-flow sensor between term. 5 and term. 4	
at ambient temperature (+15°C...+30°C):	1450...3300 Ω
Temperature sensor (engine) (plug color blue)	
Internal resistance	
at + 15° C...+ 30° C :	1450...3300 Ω
with engine at operating temp. (approx. + 80° C):	280... 360 Ω
Solenoid-operated injection valve	
Internal resistance at ambient temperature (+ 15° C...+ 30° C):	14,5 ... 17 Ω
Air-flow sensor	
Internal resistance between	
term. 2 and term. 4 :	8...2500 Ω (*)
term. 3 and term. 4 :	500...1100 Ω

(*) Slowly deflect sensor flap as far as it will go. Fluctuating increase in resistance with slight decrease towards end.

Engine-speed/reference-mark sensor		
Internal resistance between term. 1 and term. 2 at ambient temperature (+15°C...+30°C):		400...800 Ω
Air gap:		0,8 ± 0,5 mm
Throttle-valve switch		
Resistance value of idle contact term. 1 (6)* and term. 2 (4)* :	Approx.	0 Ω
Resistance value of full-load contact term. 3 (5)* and term. 2 (4)* :	Approx.	0 Ω
Idle actuator		
Internal resistance at +15°...+30°C between		
term. 1 and term. 2 :		19... 25 Ω
term. 3 and term. 2 :		17... 23 Ω
Lambda sensor		
Resistance value of heater winding (sockets 3 and 4 in 4-pole pin terminal for lambda sensor) :		1... 15 Ω
Ignition coil		
Primary resistance:	Approx.	0,5 Ω
Secondary resistance:		
Rod-type coil		4300...7700 Ω
Plastic coil (new)		6500...11500 Ω
Interference-suppression resistors		
High-voltage distributor rotor:		1 k Ω
High-voltage distributor domes:	Each	1 k Ω
Spark-plug connectors:	Each	5 k Ω
Spark plugs:		5 k Ω
Ignition coil:		1 k Ω

*) Value in brackets applies to version with electronic transmission control

TEST SPECIFICATIONS (CONTINUED)

High-voltage sensor:
Internal resistance
between term. 1 and term. 2: Approx. 0,2...1 Ω

Tank ventilation valve:
(only in vehicles with catalytic converter)
Internal resistance at
ambient temperature (+15°C...+30°C): 35...55 Ω

Idle test:
Engine at operating temperature,
switch off loads.

Idle speed	3,0 l:	800 ± 50 min $^{-1}$
	3,5 l:	800 ± 50 min $^{-1}$
Ignition angle	3,0 l:	10 ± 5° CS
	3,5 l:	10 ± 5° CS

(Automatic transmission on N or P)

CO content: without catalytic converter: 1,0 ± 0,5 vol.%
CO
Adjust mixture at bypass screw in
air-flow sensor:
Turning in an anti-clockwise direction
produces leaner mixture,
turning in a clockwise direction
produces richer mixture.

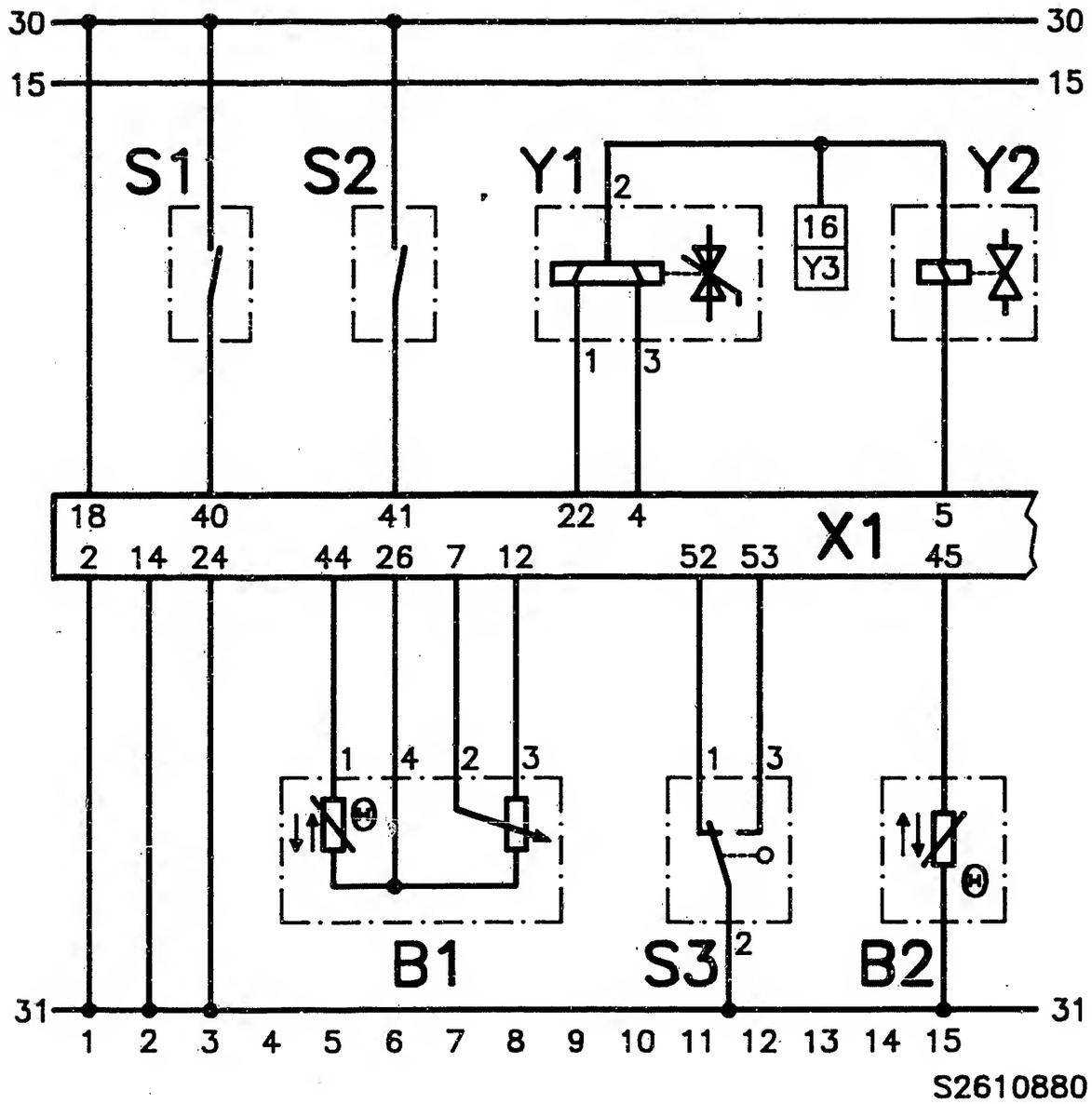
Vehicles with catalytic converter: 0,7 ± 0,5 vol.%
CO
(Measure CO ahead of catalytic converter)

Please refer to equipment and Autodata microcard for settings as regards valve clearance and other engine-related data.

K17 — <==

For production reasons:
continued on the following
coordinate.

K18 — => <=



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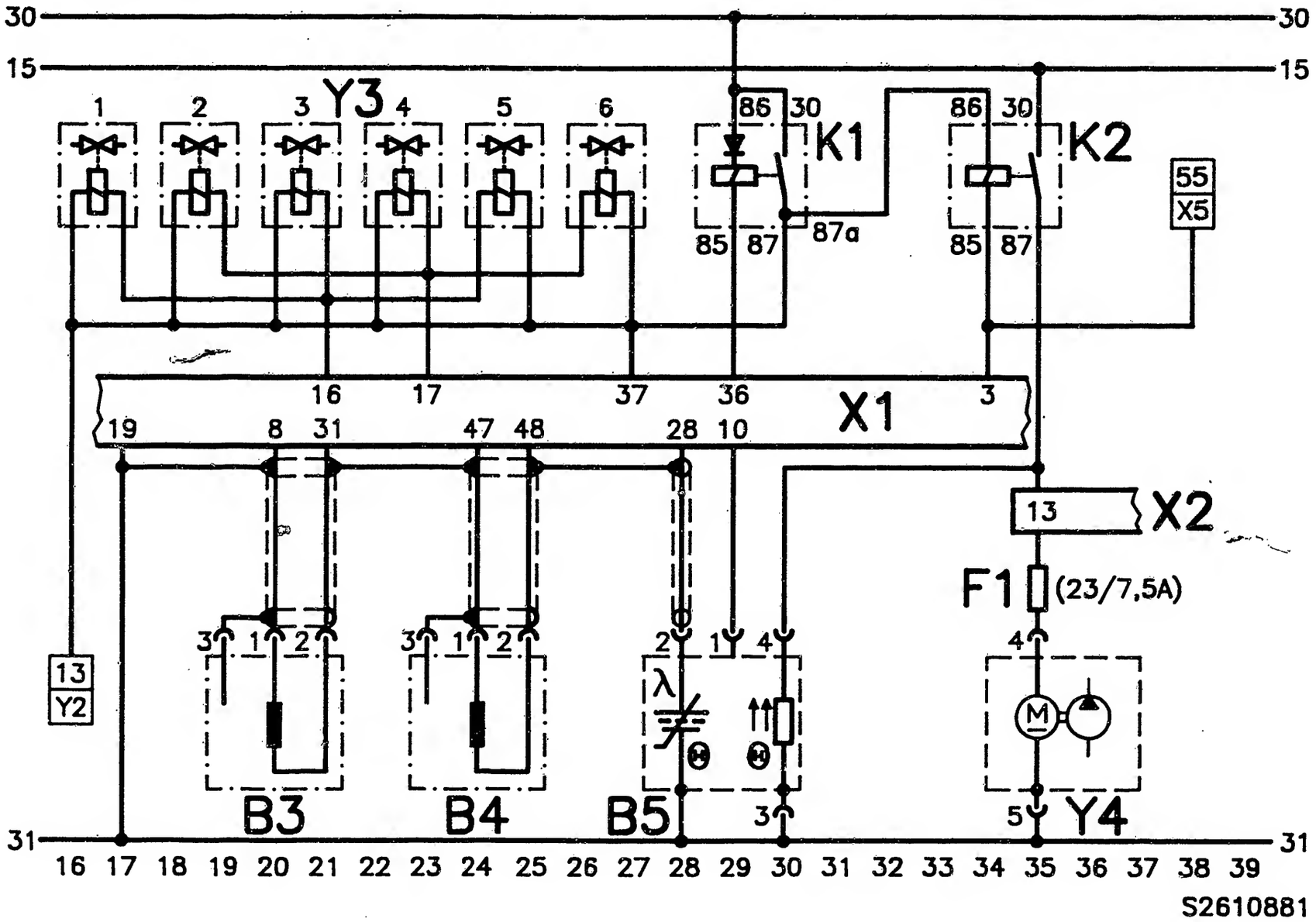
ELECTRICAL TERMINAL DIAGRAM

B1 = Air-flow sensor
B2 = Coolant temperature sensor
S1 = A/C compressor switch
S2 = A/C switch
S3 = Throttle-valve switch
(manual transmission)

X1 = Motronic control-unit plug
Y1 = Idle actuator
Y2 = Tank ventilation valve (cat.)
Y3 = Solenoid-operated injection valves

K19 —⟹

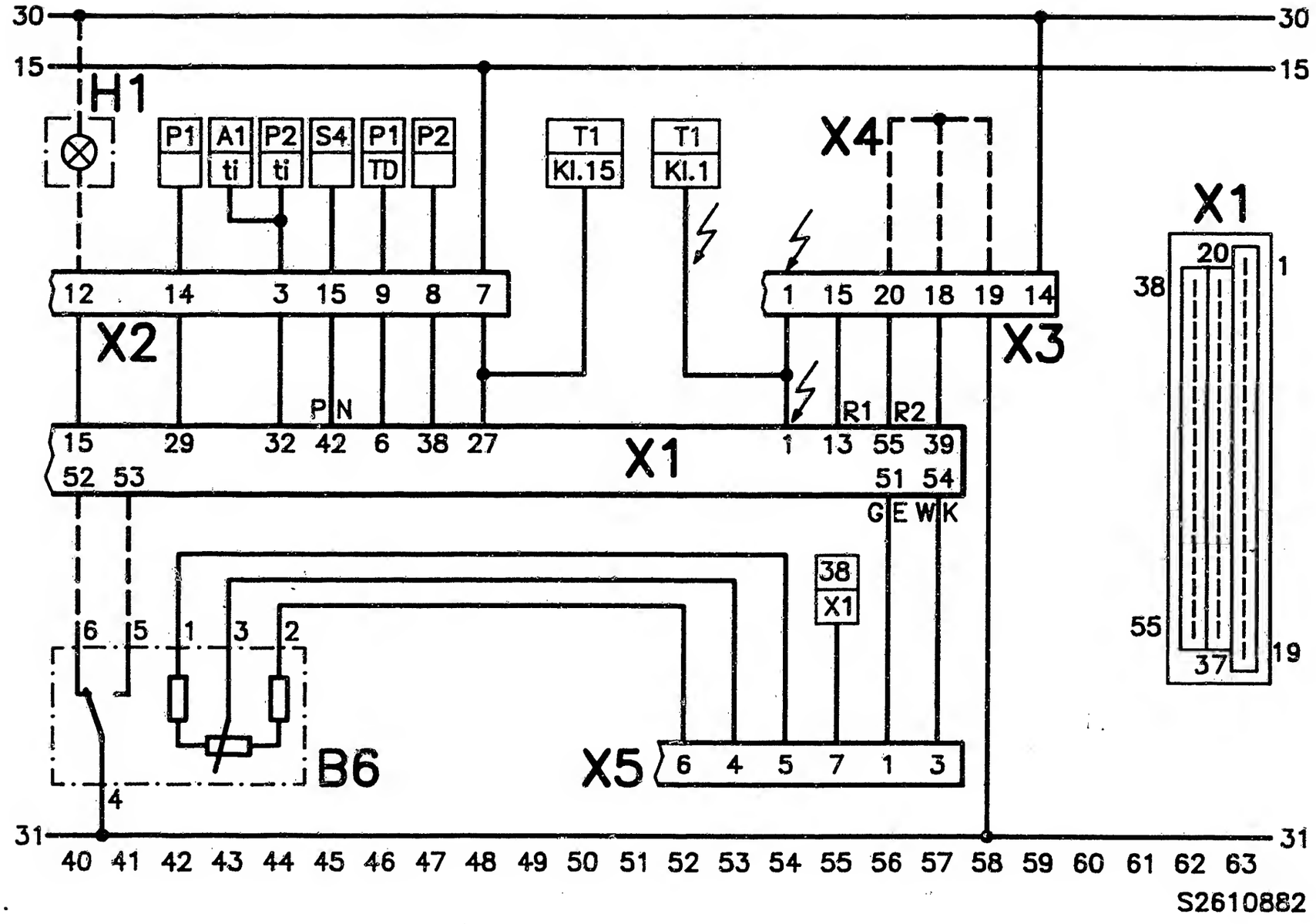
K20 —⟺



ELECTRICAL TERMINAL DIAGRAM (CONTINUED)

B3 = High-voltage sensor
B4 = Engine-speed/reference-mark sensor
B5 = Heated lambda sensor (cat.)
F1 = Pump fuse (No. 23)
K1 = Main relay
K2 = Pump relay
X1 = Motronic control-unit plug
X2 = Engine plug
X5 = Plug connection to transmission control unit (with transmission control)
Y2 = Tank ventilation valve (cat.)
Y3 = Solenoid-operated injection valves
Y4 = Electric fuel pump

K21 — ⟸
K22 — ⟸



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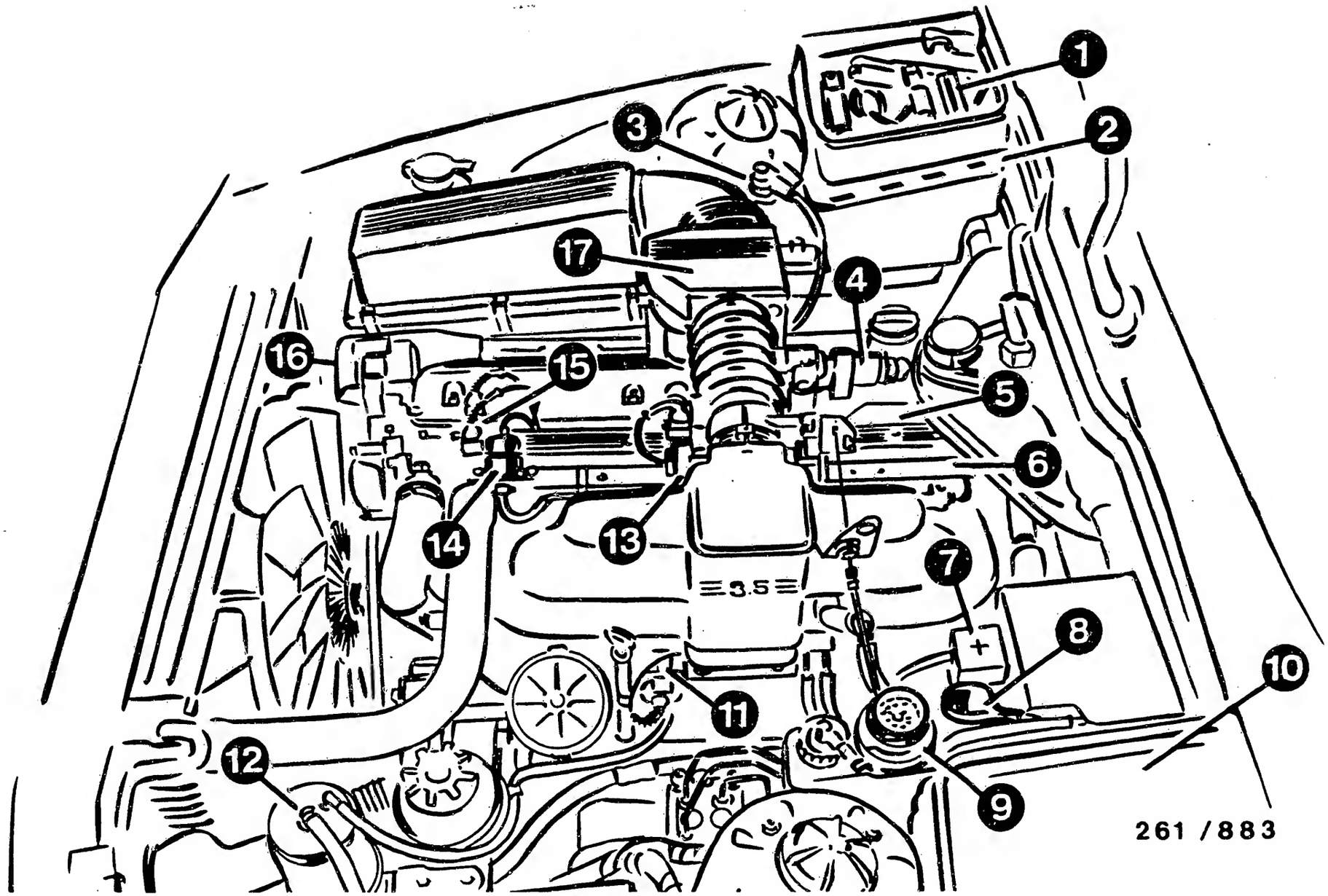
ELECTRICAL TERMINAL DIAGRAM (CONTINUED)

A1 = Transmission control unit (for vehicles with transmission control)
B6 = Throttle-valve switch with potentiometer (for vehicles with transmission control)
H1 = "CARB" lamp (fault lamp; US version only)
P1 = Instrument cluster
P2 = Vehicle computer
S4 = Position switch (automatic transmission only)
T1 = Ignition coil
X1 = Motronic control-unit plug
X2 = Engine plug
X3 = Diagnosis socket
X4 = Jumper in cover
X5 = Plug connection to GS
R1 = Stimulation lead
R2 = Serial interface

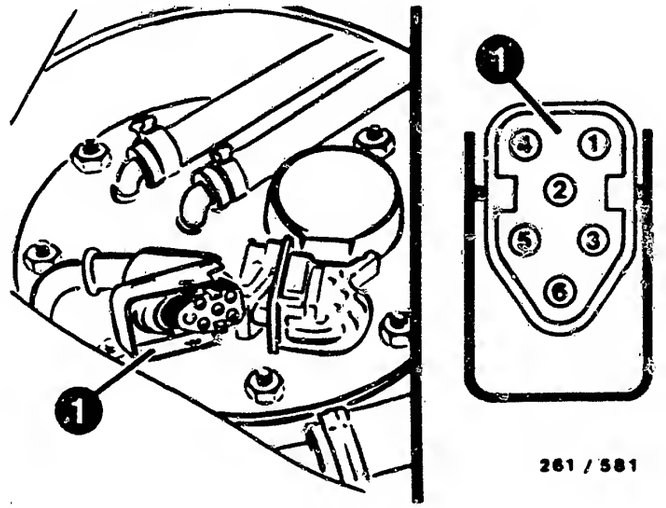


INSTALLATION POSITION OF COMPONENTS

1= Motronic control unit
2= Motronic ground terminal (beneath cover)
3= Ignition coil
4= Idle actuator
5= Cover over solenoid-operated injection valves
6= Fuel-distribution pipe
7= Battery positive terminal
8= Engine plug
9= Diagnosis socket
10= Fuse box
11= Tank ventilation valve
12= Active-carbon container
13= Throttle-valve switch
14= Fuel pressure regulator
15= Temperature sensor (engine)
16= High-voltage distributor
17= Air-flow sensor

INSTALLATION POSITION OF COMPONENTS (CONTINUED)

Electric fuel pump:
Installed in tank; access via cover in trunk to right of spare wheel (top picture).
Note: Item 1 = Connector for pump and fuel gauge.

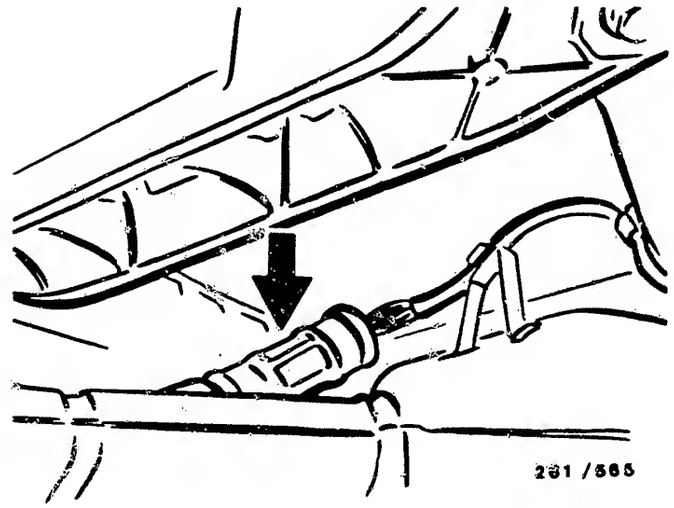


261 / 581

Fuse No. 23 for electric fuel pump:
In fuse box.

Lambda sensor (for cat.):
Installed in top of catalytic converter (center picture, arrow).

Plug connection for lambda sensor (round, 4-pole):
At rear left of engine block beneath starting motor.
(bottom picture, arrows).


261 / 565

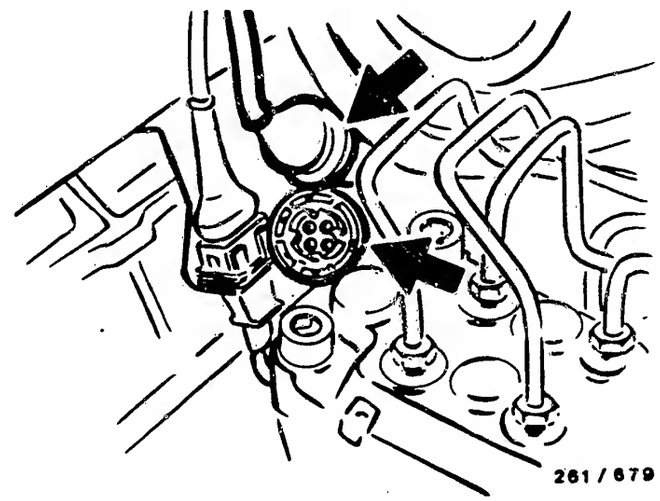
Main relay (white) and pump relay (orange):
In E-Box.

Temperature sensor (air):
In air-flow sensor.

Engine-speed/reference-mark sensor:
At front of engine, to right of crankshaft ring gear.

High-voltage sensor:
On high-tension ignition cable to cylinder 6.

Fuel filter:
On right beneath vehicle, ahead of fuel tank.


261 / 679

Trouble-shooting instructions : OPE-5003

BOSCH system : Motronic ML 4.1

Make of vehicle : OPEL

Basic microcard : PKW-050

TABLE OF CONTENTS

SPECIAL FEATURES

These trouble-shooting instructions, valid at the time of publication, apply to the following vehicle models:

* OPEL Ascona and Kadett
  with 2.0 l / 4-cylinder engine
  Engine type OHC, C 20 NE, 20 NE, 20 SEH
  (10.86 ->)

* Motronic ML 4.1 with self-diagnosis

* The fault memory can be read out using the Pocket System Tester KTS 300 (0 684 400 300) with the program module PPG 204 as of status 09.01.89.

  Note:
  Further diagnosis possibilities (actuator diagnosis etc), which would be feasible with newer program-module statuses, are not evaluated with these vehicles.

  Pay attention to operating instructions for KTS 300. Connection of the KTS 300 to the diagnosis socket in the vehicle is via the adapter lead 1 684 465 187 (OPEL).

* As an alternative to the KTS 300, the self-diagnosis can be read out by way of a flashing code (not possible with all control units).

* Joint sensor for engine speed and reference mark

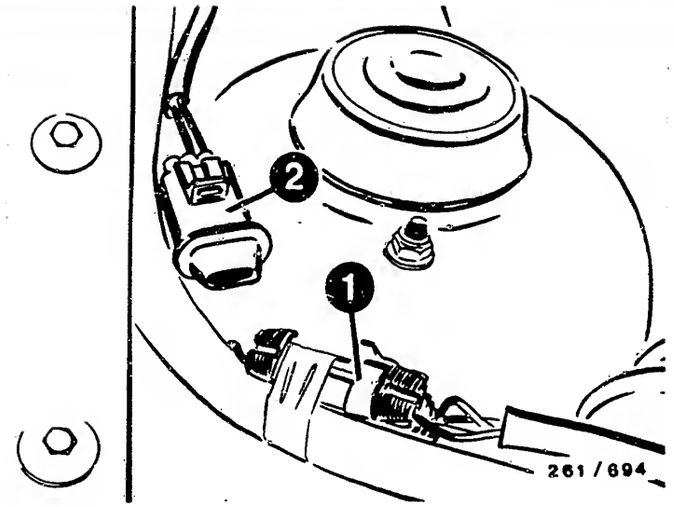
* Single-winding rotary actuator

* Lambda closed-loop control

* Variant encoding for octane-number adjustment and transmission

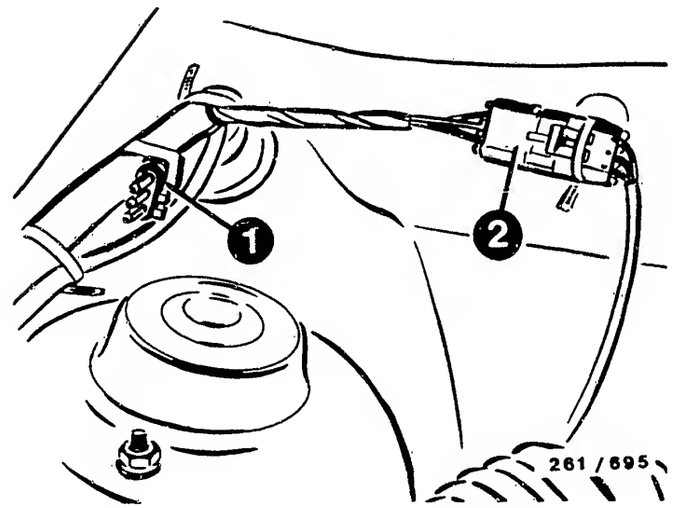
Variant coding

Octane rating	Resistance at term. 15 2 l engine, low compression (9.2) without cat. converter	 with cat. converter with cl.-loop control	 2 l engine, high compression (10), without catal. converter
91 RON	0 Ω 1)	0 Ω 1)	—
	infinity Ω 2)	infinity Ω 2)	—
	—	750 Ω 2)3)5)	—
95 RON	220 Ω 1)	220 Ω 1)	220 Ω 1)
	1200 Ω 3)4)	1200 Ω 3)	1200 Ω 3)4)
	2200 Ω 2)	2200 Ω 2)	2200 Ω 2)
	4700 Ω 2)3)4)	4700 Ω 2)3)	4700 Ω 2)3)4)
	750 Ω 2)3)4)5)	—	infinity Ω 2)3)4)5)
98 RON	470 Ω 1)	—	470 Ω 1)
			750 Ω 2)



1 = Diagnostic plug
2 = Octane-rating encoding plug (term. 15)

91 RON = Regular gasoline, unleaded or leaded, for vehicles without catalytic converter
95 RON = Premium gasoline, unleaded
98 RON = Premium gasoline, leaded
1) Basic value
2) Idle speed is increased by 100 min $^{-}$.
3) Acceleration enrichment is enriched.
4) Mixture is enriched: lambda +5% corresponds to approx. 1% CO.
5) Ignition timing amounts to −5.25 ° crankshaft (retarded) throughout the whole characteristic-map range.



1 = Encoding plug for term. 27
2 = Plug-in connection for lambda sensor

Vehicles with catalytic converter: term. 27 infinity Ω (open)

Vehicles without catalytic converter: term..27 zero Ω (to ground)

Vehicles with manually shifted transmission:
term. 10 infinity Ω (open)
term. 28 zero Ω (to ground)

Vehicles with automatic transmission:
term. 10 zero Ω (to ground)
term. 28 to selection-lever positions P and N: zero Ω (via selection lever to ground). In this way, idle speed is dropped in order to prevent driving off. In all other selection-lever positions, term. 28 is open (0 Ω)

STRUCTURE AND USAGE

These brief instructions encompass essentially vehicle-specific special features and test specifications (set values).

In accordance with the customer complaint, the trouble-shooting chart leads to different causes/component faults.
For a detailed description of trouble-shooting, see the information in the trouble-shooting chart of the basic instructions.

ATTENTION: Even if reference is made to basic instructions, the set values, terminal assignments and special features of these vehicle-related brief instructions are always binding.

SAFETY AND PRECAUTIONARY MEASURES

In order to keep persons out of danger and to avoid damage to the engine, trigger boxes and control units or to the ignition system, observe the information in the basic instructions.

CAUTION!
High-performance ignition system with dangerous primary and secondary voltages!

Touching voltage-carrying components or terminals may prove fatal (both on the primary and secondary sides).

Avoid fuel injection and high-tension flashover when testing compression!
Motronic relay is therefore to be disconnected.

TROUBLE-SHOOTING CHART

Customer complaint (symptoms of trouble)

1. Starting motor operates, but engine fails to start or starts only with difficulty.	2. Engine starts but then dies.	3. Rough idling (engine speed, exhaust gas).	4. Poor throttle response, flat spot during acceleration.	5. Engine misfiring (ignition, injection).	6. Maximum engine power/top speed not reached.	7. Fuel consumption too high.	8. Engine running on (dieseling).	9. Engine pinging/knocking.	10. Engine overheating.	11. Fault lamp.	Cause (component fault)
*	*	*	*	*	*	*	*	*	*	*	Self-diagnosis
*											Voltage at control unit
*											Sensor
*		*			*	*					Fuel pressure
*		*				*	*				Solenoid-operated injection valves
		*	*								Idle contact
					*						Full-load contact
	*	*	*	*	*	*					Air-flow sensor
	*	*	*								Idle actuator
*	*	*	*								Air-induction system
		*									Idle speed
*		*		*	*						Ignition coil
*		*	*	*	*						Primary signal
		*	*	*	*	*					Secondary pattern
*	*	*	*		*	*		*	*		Ignition point
		*									Exhaust gas
		*									Overrun cut-off
		*	*	*							Interference-suppression resistors
		*	*	*							Noise test
					*						Interference

TROUBLE-SHOOTING CHART (CONTINUED)

Customer complaint (symptoms of trouble)

1. Starting motor operates but engine fails to start or starts only with difficulty.	2. Engine starts but then dies.	3. Rough idling (engine speed, exhaust gas).	4. Poor throttle response, flat spot during acceleration.	5. Engine misfiring. (ignition, injection).	6. Maximum engine power/top speed not reached.	7. Fuel consumption too high.	8. Engine running on (dieseling).	9. Engine pinging/knocking.	10. Engine overheating.	11. Fault lamp.	Cause (component fault)
			*							*	Throttle valve
			*								Fuel delivery
*	*	*									Air bleed of tank
	*	*									Lambda closed-loop control
*	*	*	*	*	*	*		*	*	*	Control unit

SELF-DIAGNOSIS TEST TABLE

Pocket system tester Fault indication	Fault code	Flashing code	Test instructions/Test conditions	Terminals	Set values
Data exchange not possible			Ignition on: Fault lamp lights up. Prerequisite for fault output: Leads to diagnosis plug/fault lamp and power supply for control unit including term. 18 O.K. Leads and power supply O.K., but no fault output: Control unit defective.	4, 12, 17, 18	———
Lambda sensor Open circuit	13	1 3	Open-circuit in lead to lambda sensor. Sensor defective.	24	———
Engine temp. sensor Short to ground	14	1 4	Test temperature sensor and lead for short-circuit to ground (short to ground).	13	———
Engine temp. sensor Op. circ./sh. to B+	15	1 5	Test temperature sensor and leads for open-circuit (op. circ.) and short-circuit to positive (sh. to B+). Temperature-sensor resistance: at +15...+30°C : at approx. +80°C :	13, ground	 1450...3300 Ω 280....360 Ω
Lambda sensor Short to ground	44	4 4	Test lead for short-circuit to ground (short to ground). Watch out for worn cable insulation! Pronounced leaning, e.g. tank run empty.	24	———
Lambda sensor Short to B+	45	4 5	Test lead for short-circuit to positive (short to B+). Watch out for worn cable insulation! Mixture too rich.	24	———
Battery voltage too low	48	4 8	Supply voltage for control unit too low (with engine running): Test voltage dips at positive and ground terminal. Charge battery. Test alternator system.	35(+), 5(-)	Greater than 10 V
Battery voltage too high	49	4 9	Supply voltage for control unit too high (with engine running): Test alternator regulator.	35(+), 5(-)	Less than 16 V

SELF-DIAGNOSIS TEST TABLE (CONTINUED)

Pocket system tester Fault indication	Fault code	Flashing code	Test instructions/Test conditions	Terminals	Set values
Control unit Digital sec.(comput) defective	51 or 55	5 1 or 5 5	Control unit defective.	—	—
CO potentiometer Signal too low	65	6 5	Measure resistance of CO potentiometer (idle potentiometer): Test lead for short-circuit to ground. Open-circuit at term. 9. Term. 6 and term. 9 jumpered.	30	Measure resistance at air-flow sensor between term. and term. 4: Minimum 0...30 Ω Maximum: The value measured between term. 3 and term. 4 may be up to 30 Ω less. (Set value between term. 3 and term. 4: 300...550 Ω)
CO potentiometer Signal too high	66	6 6	Measure resistance of CO potentiometer (idle potentiometer): Test potentiometer and leads for open-circuit and short-circuit to positive. If there is an open-circuit at term. 6, fault code 7 4 is also displayed.	30	
Idle switch Short to ground	67	6 7	Fault: Idle contact (in throttle-valve switch) permanently closed or short-circuit to ground (short to ground) in lead. Idle contact closed in off position: Actuate throttle valve somewhat:	2, ground	 Approx. 0 Ω Infinity Ω
Air-temp. sensor Short to ground	69	6 9	Test temperature sensor and lead for short-circuit to ground (short to ground).	22	—
Air-temp. sensor Open circuit	71	7 1	Test temperature sensor and leads for open-circuit. Temperature-sensor resistance: at +15°C...+30°C:	22, 6(–)	 1450...3300 Ω
Full-load switch Short to ground	72	7 2	Fault: Full-load contact (in throttle-valve switch) permanently closed. Fault lamp lights up only intermittently during overrun. Full-load contact closed in full-throttle position: Release accelerator pedal somewhat:	3	 0 Ω Infinity Ω

SELF-DIAGNOSIS TEST TABLE (CONTINUED)

Pocket system tester Fault indication	Fault code	Flashing code	Test instructions/Test conditions	Terminals	Set values
Air-flow sensor/ Air-mass sensor Signal too low	73	7 3	Test: Lead to air-flow sensor term. 7 for short-circuit to ground, leads to term. 7 and term. 9 for open-circuit, leads to term. 6 and term. 9 for mutual contact. Air-flow sensor defective.	6(-), 7, 9(+)	———
Air-flow sensor/ Air-mass sensor Signal too high	74	7 4	Test: Lead to air-flow sensor term. 6 for open-circuit (note: fault code 66 also appears), leads to term. 6 and term. 7 for short-circuit to positive (5 V or battery positive). Test resistances of air-flow sensor: between term. 6 and term. 7 (deflect sensor flap): between term. 6 and term. 9: Air-flow sensor defective.	6(-), 7	 8...2500 Ω 300...550 Ω
Transmission identification Short to ground	75	7 5	Test lead for short-circuit to ground (short to ground) or switch (if fitted) permanently closed (faulty). Continue test with electronic transmission control.	8	———
No fault stored		1 2	Fault code 1-2 constantly repeated. Continue trouble-shooting with trouble-shooting chart.	—	———

Pressure regulator
* Fuel pressure 2,3...2,7 bar

Electric fuel pump
* Fuel delivery (measured in return line) at least 850 cm ^{3} /30s
Supply voltage (under load): at least 12 V

Temperature sensor (air)
* Internal electrical resistance measured at air-flow sensor between term. 4 and term. 5 at ambient temperature (+15°C...+30°C): 1450...3300 Ω

Temperature sensor (engine), plug color, blue.
* Internal electrical resistance at ambient temperature (+ 15° C...+ 30° C): 1450...3300 Ω
with engine at normal operating temperature (approx. + 80° C): 280...360 Ω

Solenoid-operated injection valve
* Internal electrical resistance at ambient temperature (+ 15° C...+ 30° C): 14,5...17 Ω

Air-flow sensor
* Internal electrical resistance between:
term.2 and term.4 : 8...2500 Ω (1)
term.3 and term.4 : 300... 550 Ω
term.1 and term.4 (CO potentiometer):
Minimum 0... 30 Ω
Maximum: the actual value measured between term.3 and term.4 is permitted to be up to 30 Ω less.

(1) Deflect air-flow sensor flap slowly as far as it will go.
Resistance fluctuates between the terminals of the potentiometer.

Engine-speed sensor and reference-mark sensor
* Internal electrical resistance at ambient temperature (+15°C...+30°C): 400...800 Ω
* Air gap: 0,8±0,5 mm

Throttle-valve switch
* Resistance value of idle contact term.1 and term.2): 0 Ω
* Resistance value of full-load contact (term.1 and term.3) 0 Ω

Pressure sensor (altitude sensor)
* Total resistance between term.3(+) and term.2(-) : 2300...2500 Ω
* Resistance between wiper term.1(S) and term.2(-) : 400...2300 Ω
Test specification is altitude-dependent

Idle actuator
* Internal electrical resistance at +15°...+30°C : approx. 8 Ω

Lambda sensor
* Resistance value of heater winding 1...15 Ω

Ignition coil
* Primary resistance approx. 0 Ω
* Secondary resistance 5000...7200 Ω

Interference-suppression resistors
* High-voltage distributor rotor: 1 k Ω
The secondary side of the ignition system must be interference-suppressed with at least 5k Ω total resistance. High-voltage resistance cables are installed as standard.

TEST SPECIFICATIONS (CONTINUED)

Idle test:
Engine at normal operating temp.,
switch off consuming devices.
* Idle speed: 740±40 min $^{-1}$ +)
* Spark advance: 10± 5 ° crankshaft +)

Automatic transmission at N or P

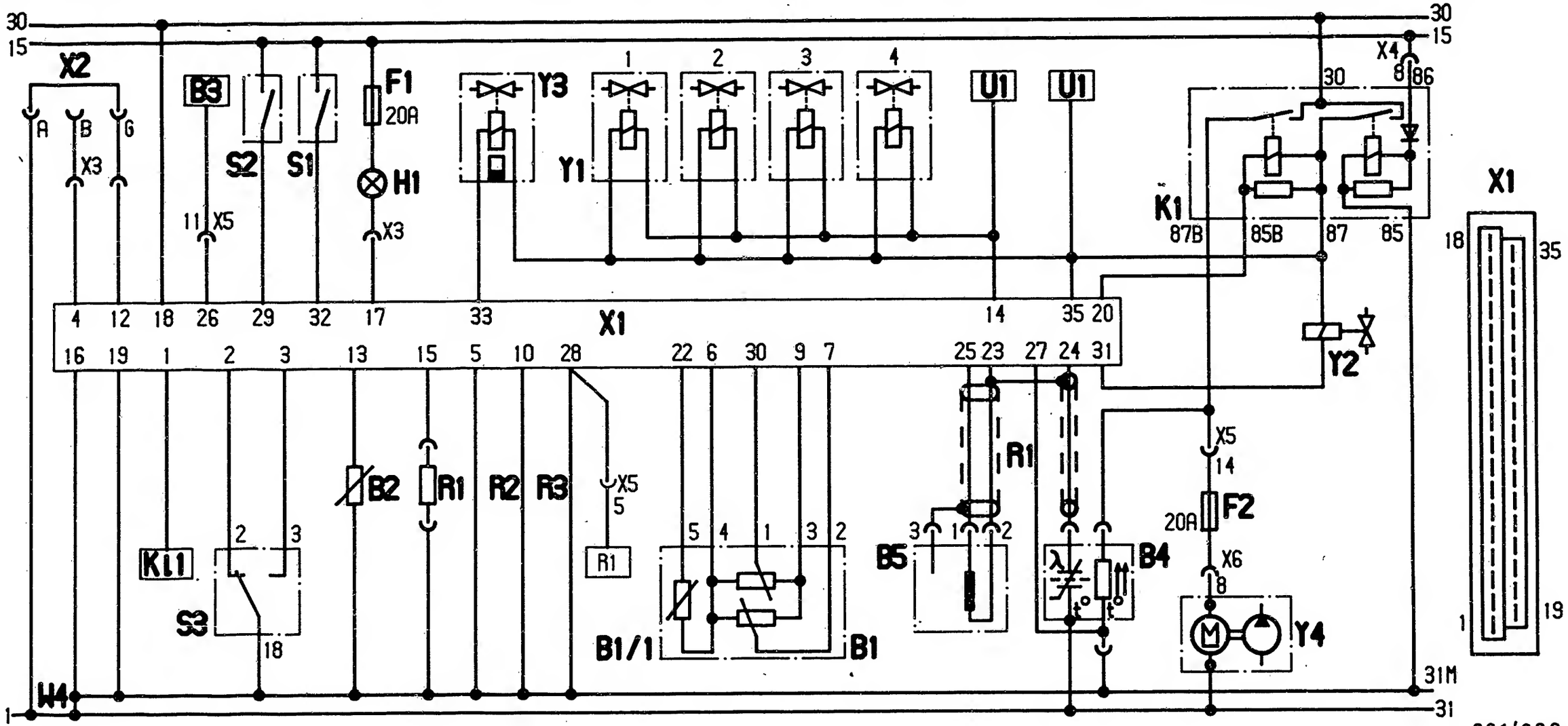
CO-content: without cat. converter
% CO by vol. 0,1...1 +)
Adjust mixture at CO
potentiometer in air-flow
sensor:
Turning counterclockwise results in a leaner mixture,
turning clockwise results in a richer mixture.
Using the potentiometer, the duration of
injection can be adjusted by max. 0,5 ms

* Catalytic-converter vehicles:: 0 % CO by vol.

+) Attention! The basic value stated may deviate due to variant coding. Observe table in "Special features" section.

See equipment and Autodata microcards for setting values for valve clearance and other engine-specific data.

For production reasons:
continued on the following
coordinate.



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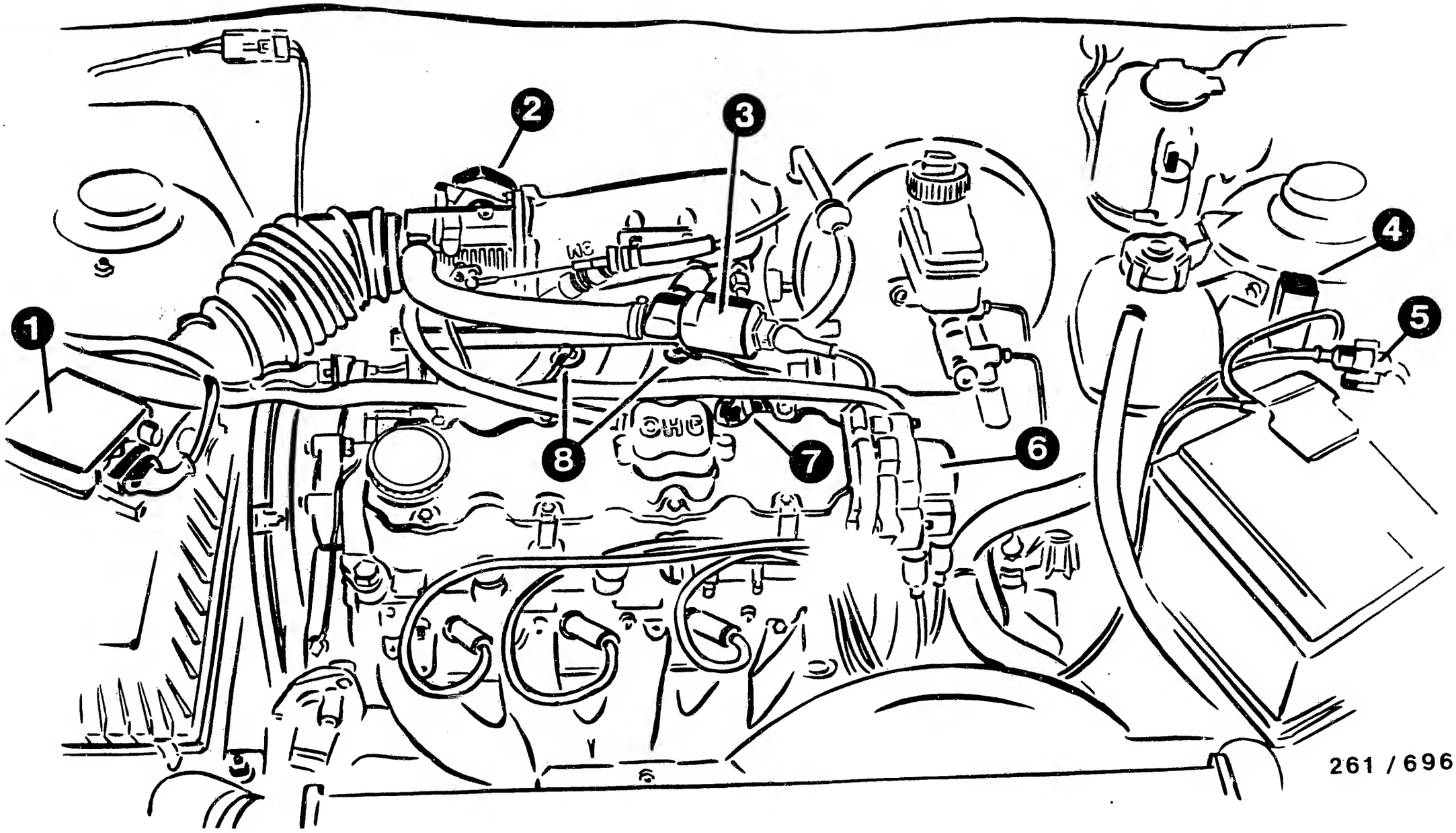
ELECTRICAL TERMINAL DIAGRAM

B1 = Air-flow sensor
B1/1= Temperature sensor (air)
B2 = Temperature sensor (engine)
B3 = Dist.-travelled freq. sensor
B4 = Lambda sensor
B5 = Engine-speed/ref.-mark sensor
F1,F2 = Fuse 20 A
H1 = Fault lamp
K1 = Motronic relay
K1.1= Ignition coil term. 1
R1 = see variant encoding
R2 = Automatic transmission only
R3 = Manual transmission only
S1 = A/C
S2 = Switch, compressor
S3 = Throttle-valve switch
U1 = Vehicle computer
W4 = Engine ground strap
X1 = Motronic control-unit plug
X2 = Diagnosis plug
Y1 = Injection valves
Y2 = Tank ventilation valve
Y3 = Idle actuator
Y4 = Electric fuel pump

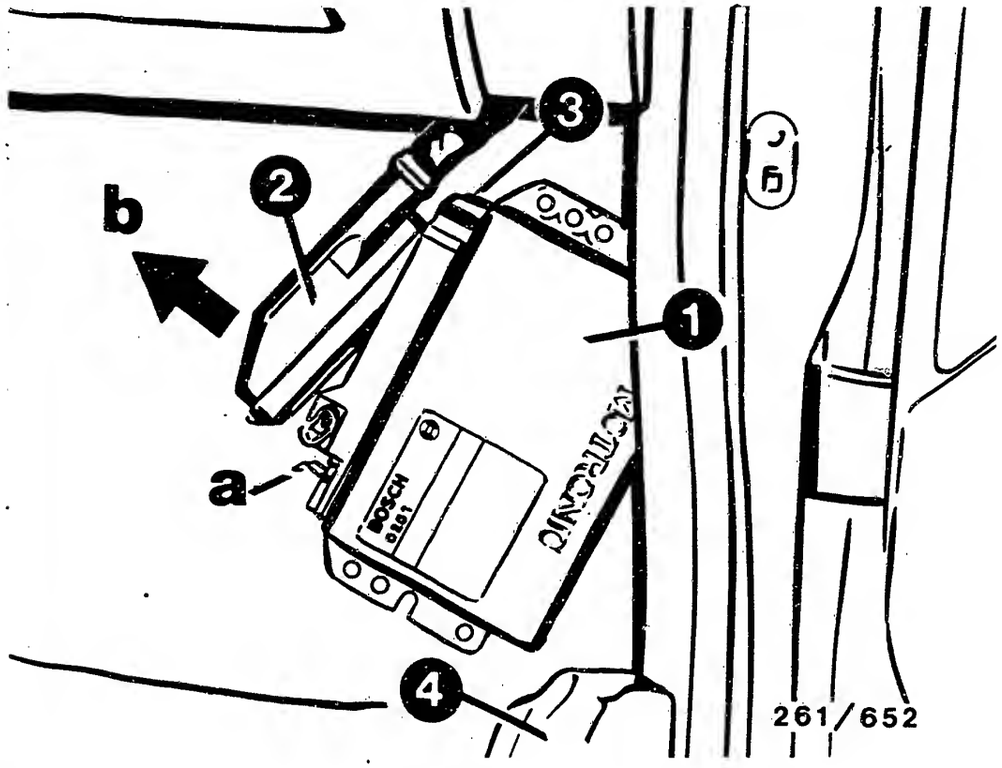
L19 — ⟹

L20 — ⟸



INSTALLATION POSITION OF COMPONENTS

1 = Air-flow sensor
2 = Throttle-valve switch
3 = Idle actuator
4 = Motronic relay
5 = Ignition coil
6 = High-voltage distrib.
7 = Pressure regulator
8 = Injection valve



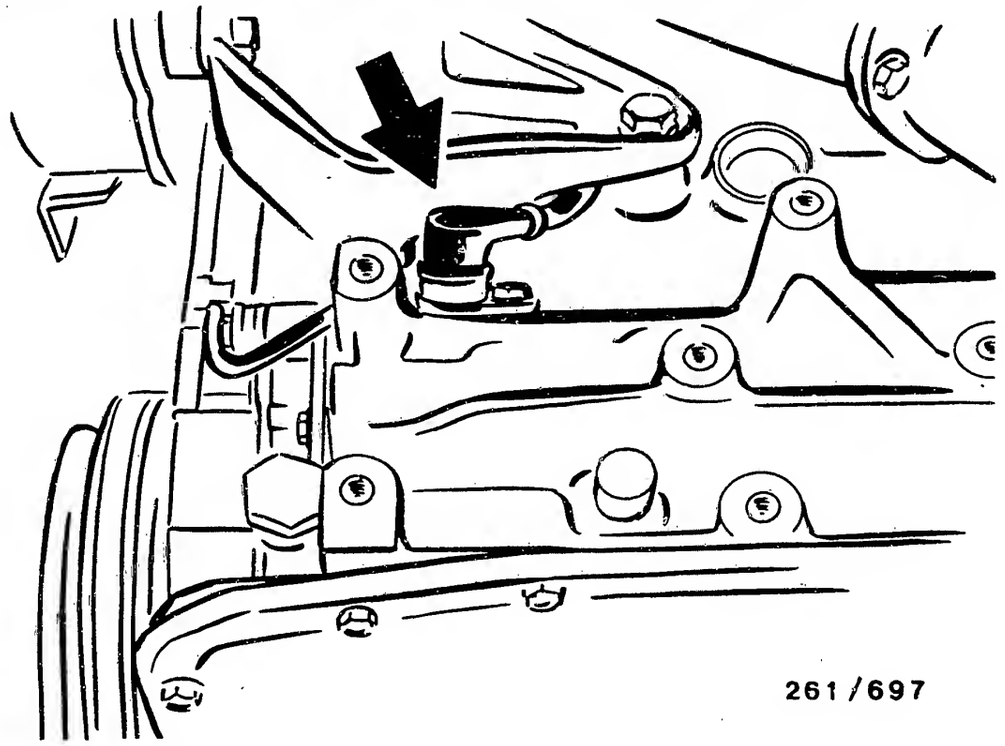
1 = Control unit
2 = Plug
3 = Mechanical encoding with locking lug
4 = Cover over door sill

INSTALLATION POSITION OF COMPONENTS (CONTINUED)

The indications "left" and "right" refer always to the forward direction of travel.

* Control unit:
  In front-passenger footwell on right-hand side. Slightly raise rubber strip and cover on door sill. Fold carpet to side and remove control-unit cover. Unscrew control unit. Unlock plug (a), hinge (arrow b) and unhook (Item 3).

* Temperature sensor (engine):
  In engine block below mounting of alternator.



Arrow = Reference-mark/engine-speed sensor

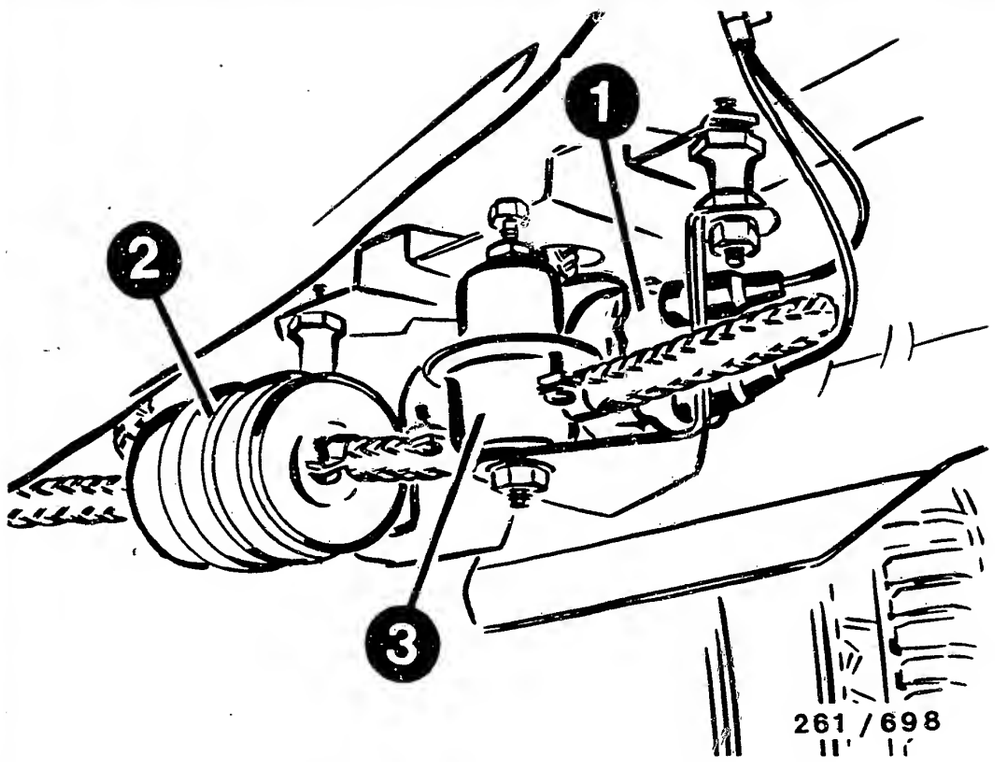
INSTALLATION POSITION OF COMPONENTS (CONTINUED)

* Reference-mark/engine-speed sensor:
  In engine block at front left, below fastening flange.

* Lambda sensor:
  In common exhaust pipe before catalytic converter.

* Fuses:
  In instrument panel at bottom left. Fuse box can be hinged out on its lower side.

* Temperature sensor (air):
  In air-flow sensor



1 = Electric fuel pump
2 = Fuel filter
3 = Pressure damper

INSTALLATION POSITION OF COMPONENTS (CONTINUED)

* Electric fuel pump and fuel filter:
  Between the fuel tank and right-hand rear wheel.

* Ground terminals:
  On the engine block at the front on the right, beneath the engine-oil filler-neck cap.

* Diagnostic plug:
  In the engine compartment on the right at the spring-strut dome.

* Octane-rating encoding plug:
  In the engine compartment on the right at the spring-strut dome.

* Tank bleeder valve:
  In the engine compartment on the left next to the ignition coil.

* Carbon filter:
  In the engine compartment on the left next to the battery.

Trouble-shooting instructions : BMW-5022

BOSCH system : Motronic M 1.3

Make of vehicle : BMW

Basic microcard : PKW-052

TABLE OF CONTENTS

SPECIAL FEATURES

These trouble-shooting instructions, valid at the time of publication, apply to the following vehicle models:

*BMW 530i with and without catalytic converter as of 02.88
Engine: 3.0 l / 6 cyl.
*BMW 535i with and without catalytic converter as of 02.88
Engine: 3.5 l / 6 cyl.

* Motronic system M 1.3 with self-diagnosis and flashing-code output (55-pole plug).

* The fault memory can be read out using the Pocket System Tester KTS 300 (0 684 400 300) with the program module PPG 204 as of status 09.01.89.

  Note:
  Further diagnosis possibilities (actuator diagnosis etc), which would be feasible with newer program-module statuses, are not evaluated with these vehicles.

  Pay attention to operating instructions for KTS 300. Connection of the KTS 300 to the diagnosis socket in the vehicle is via the adapter lead 1 684 463 196 (BMW).

* As an alternative to the KTS 300, the self-diagnosis can be read out by way of a flashing code (not possible with all control units).

* The self-diagnosis test table takes account of both the KTS 300 and the flashing code and is arranged according to fault-code nos. indicated by the KTS 300. In some cases, the "fault indication" column includes two types of fault which can be optionally indicated by the tester, e.g:
  Short-circuit to ground (= 1st type of fault)
  Short-circuit to positive (= 2nd type of fault)

SPECIAL FEATURES (CONTINUED)

* Initiation (stimulation) and continuation of the flashing-code fault output are effected by pressing the full-load switch 5 times (accelerate to full throttle 5 times within 5 seconds with ignition switched on).
  Every flashing code is continuously output until continuation is effected.
  As a last step, the flashing code 0 0 0 0 or 1 0 0 0 appears = end of output.
  The fault memory is cleared by closing the full-load switch for at least 10 seconds during output of the flashing code "end of output".
  Termination of self-diagnosis: Switch off ignition.

* Control unit with variant encoding.
  Important:
  Please refer to basic instructions for information which has to be given when ordering control unit.

* Group injection: Division into 2 groups which inject at different times (except during warm-up phase and on acceleration).
  Synchronization by way of sensor on ignition cable of cyl. 6.
  Group 1: Cylinders 1,3,5
  Group 2: Cylinders 2,4,6

* Adaptive lambda closed-loop control and tank ventilation with pulsed valve (for cat.).

* Note on trouble-shooting:
  If vehicle computer and/or burglar alarm fitted, attention is to be paid to the following:
  If the code for depriming the system was entered incorrectly or if there is a defect in the vehicle computer/burglar alarm, positive is switched to term. 38 of the Motronic control unit.
  The engine cannot be started.
  For rapid testing, disconnect vehicle computer and alarm-system module and repeat attempted starting (no voltage at term. 38).

STRUCTURE AND USAGE

These brief instructions encompass essentially vehicle-specific special features and test specifications (set values).

In accordance with the customer complaint, the trouble-shooting chart leads to different causes/component faults.
For a detailed description of trouble-shooting, see the information in the trouble-shooting chart of the basic instructions.

ATTENTION: Even if reference is made to basic instructions, the set values, terminal assignments and special features of these vehicle-related brief instructions are always binding.

SAFETY AND PRECAUTIONARY MEASURES

In order to keep persons out of danger and to avoid damage to the engine, trigger boxes and control units or to the ignition system, observe the information in the basic instructions.

CAUTION!
High-performance ignition system with dangerous primary and secondary voltages!

Touching voltage-carrying components or terminals may prove fatal (both on the primary and secondary sides).

* Avoid injection of fuel and high-voltage flashovers when testing the compression.
  Therefore, disconnect Motronic relay.

TROUBLE-SHOOTING CHART

Customer complaints (symptoms of trouble)

1. Starting motor operates, engine fails to start or starts only with difficulty.	2. Engine starts but but then dies.	3. Rough idling (engine speed, exhaust gas).	4. Poor throttle response, flat spot during acceleration.	5. Engine misfiring (ignition, fuel injection).	6. Maximum engine power/ top speed not reached.	7. Fuel consumption too high.	8. Engine running on (dieseling).	9. Engine pinging/knocking.	10. Engine overheating.	11. Fault lamp.	Cause (component fault)
*	*	*	*	*	*	*	*	*	*		Self-diagnosis
*											Voltage at control unit
*											Engine-speed/reference mark sensor
*		*			*	*					Fuel pressure
*		*				*	*				Solenoid-operated injection valves
		*	*		*						Throttle-valve switch
	*	*	*	*	*	*					Air-flow sensor
	*	*	*								Idle actuator
*	*	*	*								Air-intake system
		*									Idle speed, CO
*		*		*	*						Ignition coil
*		*	*	*	*						Primary signal
		*	*	*	*	*					Secondary pattern
*	*	*	*		*	*		*	*		Ignition point
*				*							High-voltage sensor
		*									Overrun cut-off
		*	*	*							Interference-suppression resistors
		*	*	*							Noise test
					*						Interference
					*						Throttle valve
					*						Fuel delivery
	*	*	*				*				Tank vent
		*	*								Lambda closed-loop control
*	*	*	*	*	*	*	*	*	*		Control unit

For production reasons: continued on the following coordinate.

SELF-DIAGNOSIS TEST TABLE

Pocket system tester Fault indication	Fault code	Flashing code	Test instructions/Test conditions	Terminals	Set values
No exchange of data	—	—	Prerequisite for fault output: Leads to diagnosis plug/fault lamp and power supply for control unit O.K.	13 55 15 18 37	———
Control unit Digital section (computer) defective	1	1211	Control unit defective.	—	———
Relay Fuel pump Open-circuit/short-circuit to ground Short-circuit to positive	3	1261	Fault 1: Short-circuit to ground or open-circuit (op. circ.). Fault 1 is only detected if other output stages are defective. Fault 2: Short-circuit to positive: Detach pump relay and measure voltage (with respect to ground) in frame (term. 86) with ignition switched on: Resistance of relay coil (term. 85/86): Test lead to control unit (term. 3).	3	10...15 V Approx. 50...150 Ω
Idle actuator Two-winding rotary actuator 1st winding/ single-winding rotary actuator Two-winding rotary actuator 2nd winding Open-circuit/short-circuit to ground Sh.-circ. to positive	4 22	1262	Fault code 4 (22) points to current path from control unit term. 4 (22) to idle actuator (ZWD*) term. 3 (1). Test leads and plug connection of actuator for open-circuit (op. circ.), short-circuit to ground and short-circuit to positive. Winding resistance at +15...+30°C between connections 3 and 2: between connections 1 and 2: * = Two-winding rotary actuator (ZWD) fitted.	4 22	17...23 Ω 19...25 Ω
Valve Tank ventilation Open-circuit/short-circuit to ground Short-circuit to positive	5	1263	Only CAT models have tank ventilation valve. Test lead for contact with ground or positive. Valve winding resistance at +15...+30°C: If lead and valve O.K., control unit is defective. Open-circuit (op. circ.) is not detected!	5	35...55 Ω
Air-flow sensor/ air-mass meter Signal too low Signal too high	7	1215	Signal too low: Test lead to air-flow sensor term. 2 for short-circuit to ground. Open-circuit in leads to term. 2 and term. 3 or term. 4 and term. 3 jumpered. Signal too high: Test lead to term. 4 for open-circuit. Test leads to term. 4 and term. 2 for short-circuit to positive. Continued on next Coordinate.	7 12 26	———

SELF-DIAGNOSIS TEST TABLE (CONTINUED)

Pocket system tester Fault indication	Fault code	Flashing code	Test instructions/Test conditions	Terminals	Set values
Air-flow sensor (continued)			Basic tests: Test resistances at air-flow sensor: between term. 2 and term. 4 (deflect sensor flap): between term. 3 and term. 4: Measure wiper voltage at term. 2 with plug connected and ignition switched on: Sensor flap in off position: Slowly deflect sensor flap as far as full load:		 8...2500 Ω 500...1100 Ω 0,2... 0,3 V Greater than 4,2 V
Lambda closed-loop control Outside min. range Outside max. range	10	1222	Test CO content (ahead of catalytic converter): Test intake system for leaks. Test fuel pressure. Injection valves or sensor defective.	28	0,2...1,2 vol.%
Fault lamp Open-circuit/short-circuit to ground Short-circuit to positive	15	—	Test lead to fault lamp (if provided) for short-circuit to ground and short-circuit to positive. Open-circuit (op. circ.) is not detected!	15	———
Injection valves (Group 2) Open-circuit/short-circuit to ground Short-circuit to positive	16	1252	Fault: Short-circuit to ground, to UB or open-circuit in joint positive/negative lead. Test lead and valves 1, 3, 5 for short-circuit/open-circuit; if O.K., control unit is defective. Note: Open-circuits in individual injection valves are not detected.	16	4,8...5,7 Ω (3 valves in parallel) 14,5...17 Ω (1 injection valve)
Injection valves (Group 1) Open-circuit/short-circuit to ground Short-circuit to positive	17	1251	Fault: Short-circuit to ground, to UB or open-circuit in joint positive/negative lead. Test lead and valves 2, 4, 6 for short-circuit/open-circuit; if O.K., control unit is defective. Note: Open-circuits in individual injection valves are not detected.	17	4,8...5,7 Ω (3 valves in parallel) 14,5...17 Ω (1 injection valve)
Relay Sensor heater Open-circuit/short-circuit to ground Short-circuit to positive	23	1264	Test lead from control unit term. 23 to relay term. 85 for open-circuit (op. circ.), short-circuit to ground and short-circuit to positive. Detach pump relay and measure voltage (with respect to ground) in frame (term. 86) with ignition switched on: Resistance of relay coil (term. 85/86):	23	 10...15 V Approx. 50...150 Ω

SELF-DIAGNOSIS TEST TABLE (CONTINUED)

Pocket system tester Fault indication	Fault code	Flashing code	Test instructions/Test conditions	Terminals	Set values
Lambda sensor Open circuit Ground short Short to B+	28	1221	Test lead for open-circuit, short-circuit to ground and short-circuit to positive (short to B+). Watch out for worn cable insulation! Sensor heater defective. Sensor clogged.	28	———
Speed signal incorrect/no signal	29	———	Test lead for open-circuit, short-circuit to ground and short-circuit to positive. If leads and plug connections are O.K., continue trouble-shooting in instrument cluster.	29	———
Battery voltage too low too high	37	1231	Supply voltage for control unit too low: Test voltage dips at positive and ground terminal. Charge battery. Supply voltage for control unit too high: Test alternator regulator.	18 19 (+) (-)	Greater than 9 V (with engine running) Less than 16 V (with engine running)
ASR/MSR interface Short to B+	38	———	Test lead to vehicle computer/burglar alarm for short-circuit to positive (short to B+). If lead and plug connection are O.K., continue trouble-shooting in vehicle computer/burglar alarm.	38	———
Air cond. readiness/AC comp. sign. Comparison not O.K.	40	———	Test lead from control unit term. 40 to A/C compressor for short-circuit to positive. Test lead from control unit term. 41 to A/C switch (A/C readiness) for open-circuit.	40 41	———
Air-temp. sensor Op.circ./sh. to B+ Short to ground	44	1224	Test temperature sensor and lead for open-circuit (op. circ.), short-circuit to ground (short to ground) and short-circuit to positive (sh. to B+). Temperature-sensor resistance: at +15...+30°C:	44	1450...3300 Ω
Engine temp. sensor Op. circ./sh. to B+ Short to ground	45	1223	Test temperature sensor and lead for open-circuit (op. circ.), short-circuit to ground (short to ground) and short-circuit to positive (short to B+). Temperature-sensor resistance: at +15...+30°C: at approx. +80°C:	45	1450...3300 Ω 280... 360 Ω
Transmission identification Short to ground	51	1278	Applies to electronic transmission control (GS): Test lead for short-circuit to ground (short to ground) or corresponding output in transmission control unit defective. Term. 51 is open on vehicles without GS.	51	———

SELF-DIAGNOSIS TEST TALE (CONTINUED)

Pocket system tester Fault indication	Fault code	Flashing code	Test instructions/Test conditions	Terminals	Set values
Idle switch Short to ground	52	1232	Fault: Idle contact (in throttle-valve switch) permanently closed or short-circuit to ground (short to ground) in lead. Idle contact closed in off position: Actuate throttle valve somewhat:	52	 Approx. 0 Ω Infinity Ω
Full-load switch Short to ground	53	1233	Fault: Full-load contact (in throttle-valve switch) permanently closed or short-circuit to ground (short to ground) in lead. Full-load contact closed in full-throttle position: Release accelerator pedal somewhat:	53	 Approx. 0 Ω Infinity Ω
Converter clutch/ Driving pos. switch Comparison not O.K.	54 (24)	——	Note: Fault code 24 corresponds to fault code 54 Applies to electronic transmission control (GS): Test lead from control unit term. 54 for short-circuit to ground. If lead O.K., continue trouble-shooting in electronic transmission control. Term. 54 is open on vehicles without GS.	54	——
CU output stages with fin.cntling el. defective	100	——	CU = Control unit. Test following components and leads for open-circuit, short-circuit to ground and short-circuit to positive: Idle actuator, injection valves, fuel pump relay, tank ventilation valve and fault lamp if fitted.	4 22 16 17 3 5 15	——
No fault stored		4444 or 1444	Continue trouble-shooting with trouble-shooting chart.	——	——

Pressure regulator
Fuel pressure: 2,0 l: 2,3...2,7 bar
2,5 l: 2,8...3,2 bar

Electric fuel pump
Delivery
(measured in return): min. 800 cm^3 /30s

Supply voltage
(under load): min. 12 V

Intake-air temperature sensor
Internal resistance
measured at air-flow sensor
between term. 5 and term. 4

at ambient temperature
(+15°C...+30°C): 1450...3300 Ω

Coolant temperature sensor
(plug color blue)
Internal resistance

at + 15° C...+ 30° C : 1450...3300 Ω
with engine at operating
temperature (approx. +80° C): 280... 360 Ω

Solenoid-operated injection valve
Internal resistance
at ambient temperature
(+ 15° C...+ 30° C): 14,5... 17 Ω

Air-flow sensor
Internal resistance between
term. 2 and term. 4 : 8...2500 Ω (*)
term. 3 and term. 4 : 500...1100 Ω

(*) Slowly deflect sensor flap as far as it will go.
Fluctuating increase in resistance; slight decrease towards end.

Engine-speed/reference-mark sensor
Internal resistance
between term.1 and term.2 at
ambient temperature (+15°C...+30°C): 400...800 Ω
Air gap: 0,8 ± 0,5 mm

Throttle-valve switch
Resistance value of idle contact
term.1 (6)* and term.2 (4)*: approx. 0 Ω
Resistance value of full-load contact
term.3 (5)* and term.2 (4)* : approx. 0 Ω

Idle actuator
Internal resistance
at +15°...+30°C between
term.1 and term.2 : 19...25 Ω
term.3 and term.2 : 17...23 Ω

Lambda sensor
Resistance value of heater winding
(sockets 3 and 4 in 4-pole pin
terminal for lambda sensor) : 1...15 Ω

Ignition coil
Primary resistance: approx: 0,5 Ω
Secondary resistance:
Rod-type coil 4300... 7700 Ω
Plastic coil (new) 6500...11500 Ω

Interference-suppression resistors
High-voltage distributor rotor: 1 k Ω
High-voltage distributor domes: each 1 k Ω
Spark-plug connectors: each 5 k Ω
Spark plugs: 5 k Ω
Ignition coil: 1 k Ω

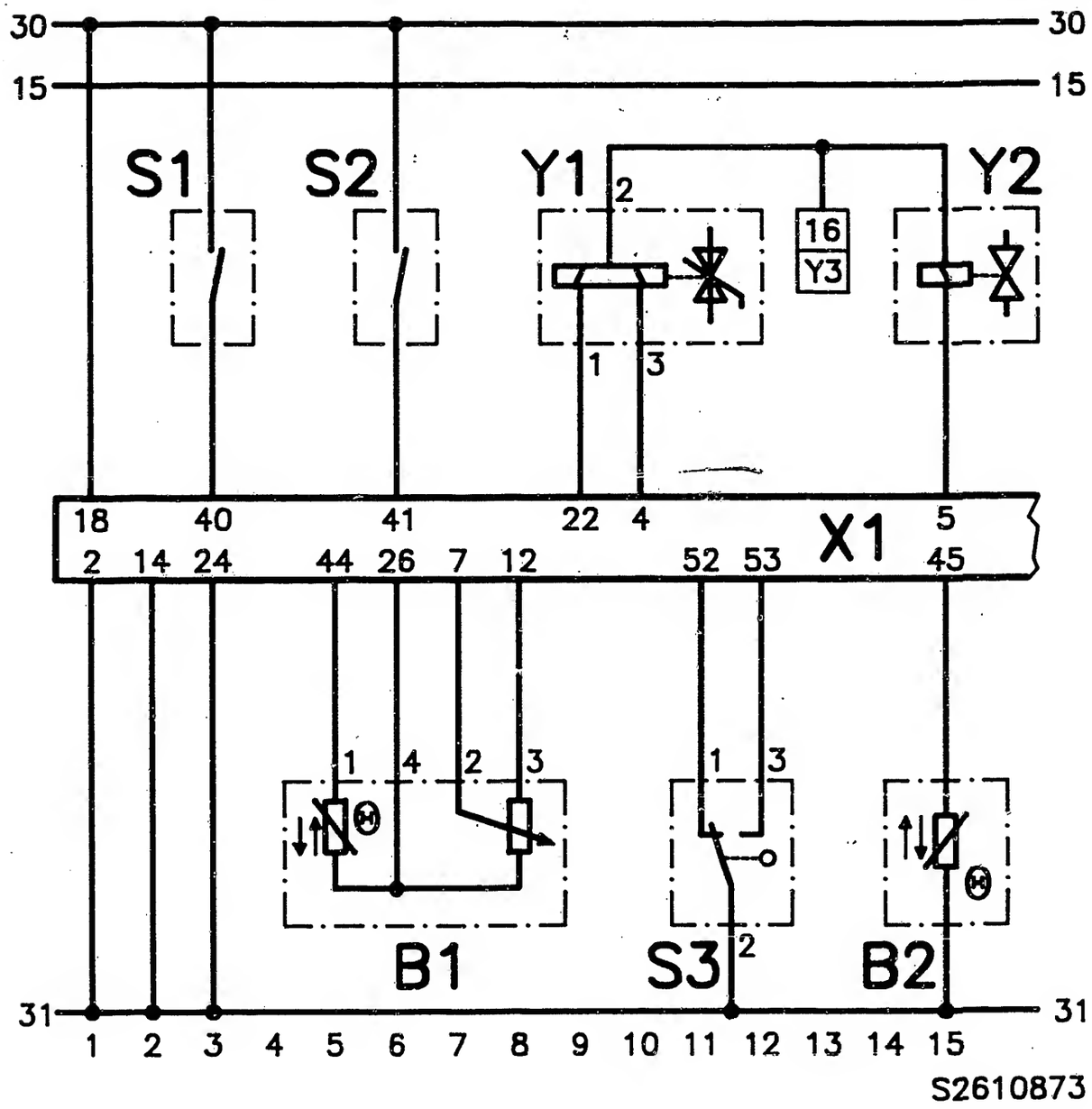
*) Number in brackets applies to version with electronic transmission control

TEST SPECIFICATIONS (CONTINUED)

High-voltage sensor: Internal resistance between term.1 and term. 2:	approx.	0,2...1 Ω
Tank ventilation valve: (catalytic-converter vehicles only) Internal resistance at ambient temperature (+15°C...+30°C):		35...55 Ω
Idle test: Engine at operating temperature, switch off loads.		
Idle speed	2,0l:	760 ± 40 min $^{-1}$
	2,5l:	760 ± 40 min $^{-1}$
Ignition angle	2,0l:	4 ± 5° CS
	2,5l:	10 ± 5° CS
(Automatic transmission on N or P)		
CO content: without catalytic conv. Adjust mixture at bypass screw in air-flow sensor: Counter-clockwise direction = leaner mixture Clockwise direction = richer mixture.		1,0 ± 0,5 vol.% CO
Catalytic-converter vehicles: (Measure CO ahead of catalytic converter)		0,7 ± 0,5 vol.% CO

Please refer to equipment and Autodata microcard for settings as regards valve clearance and other engine-related data.

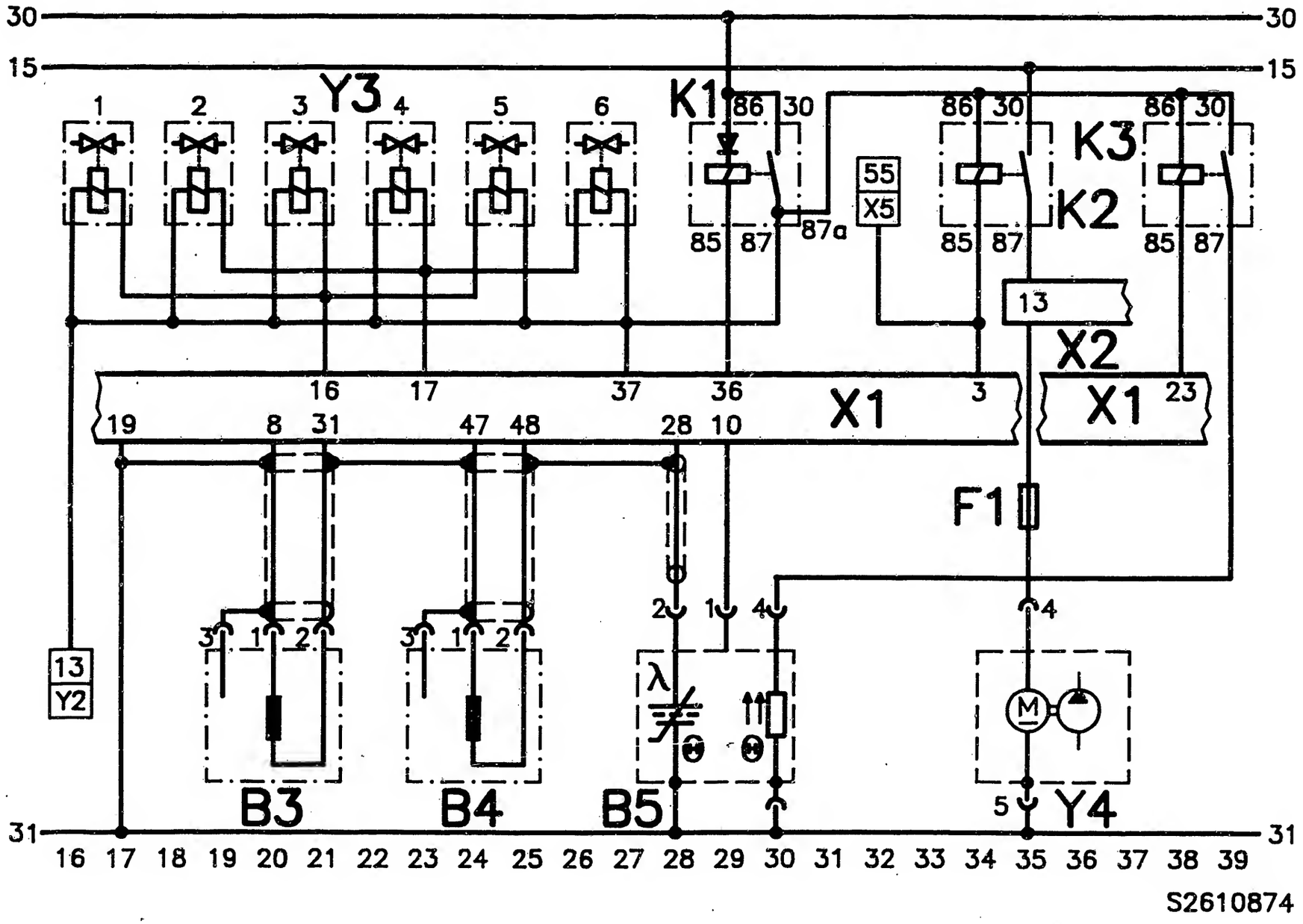
For production reasons:
continued on the following coordinate.



ELECTRICAL TERMINAL DIAGRAM

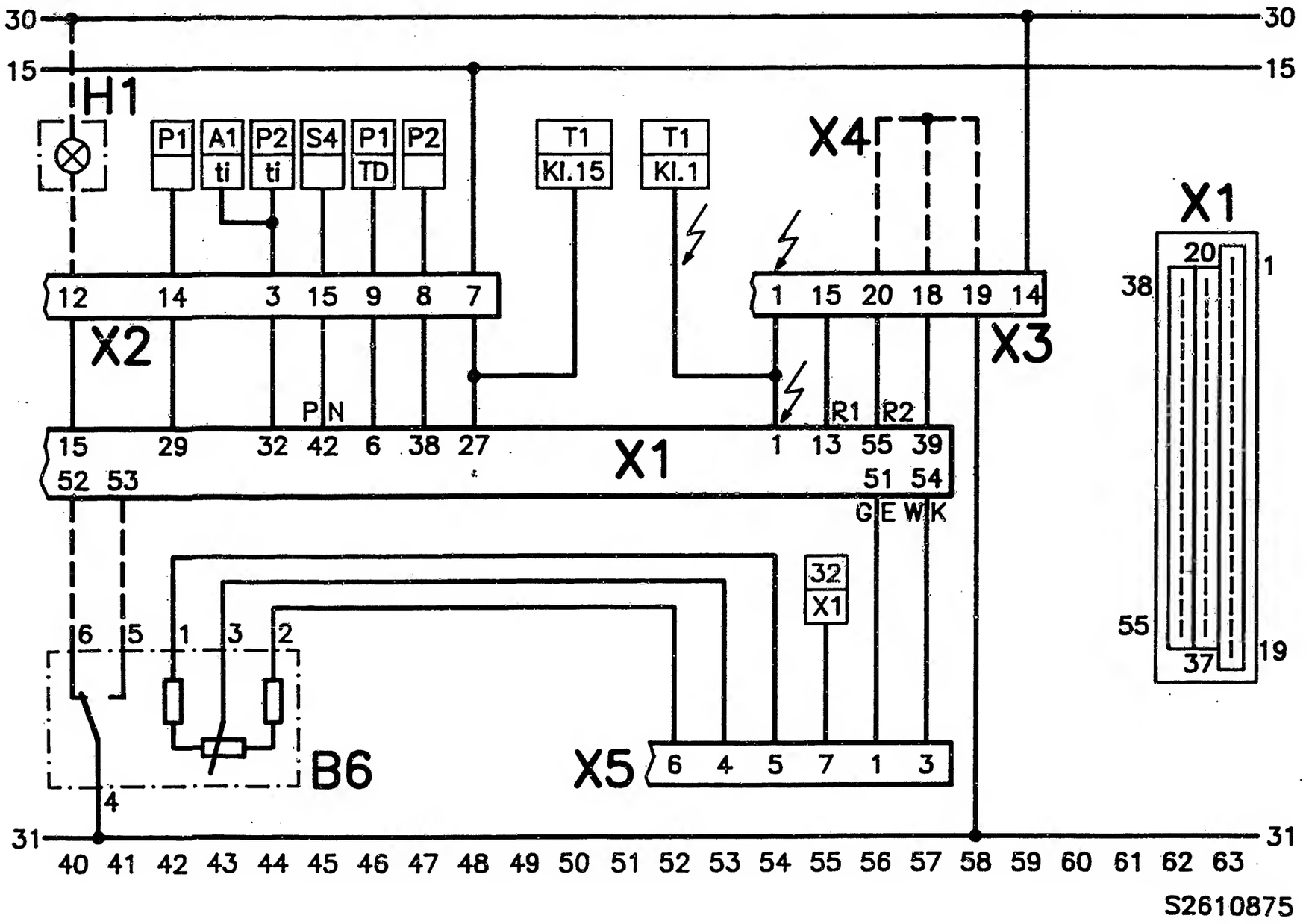
B1 = Air-flow sensor
B2 = Coolant temperature sensor
S1 = Switch to A/C compressor
S2 = Switch to A/C
S3 = Throttle-valve switch
(manual transmission)

X1 = Motronic control-unit plug
Y1 = Idle actuator
Y2 = Tank ventilation valve (cat.)
Y3 = Solenoid-operated injection valves



ELECTRICAL TERMINAL DIAGRAM (continued)

B3 = High-voltage sensor
B4 = Engine-speed/reference-mark sensor
B5 = Heated lambda sensor (cat.)
F1 = Pump fuse (No. 23)
K1 = Main relay
K2 = Pump relay
K3 = Sensor heater relay (cat.)
X1 = Motronic control-unit plug
X2 = Engine plug
X5 = Plug connection to transmission control unit (for vehicle with transmission control)
Y2 = Tank ventilation valve (cat.)
Y3 = Solenoid-operated injection valves
Y4 = Electric fuel pump



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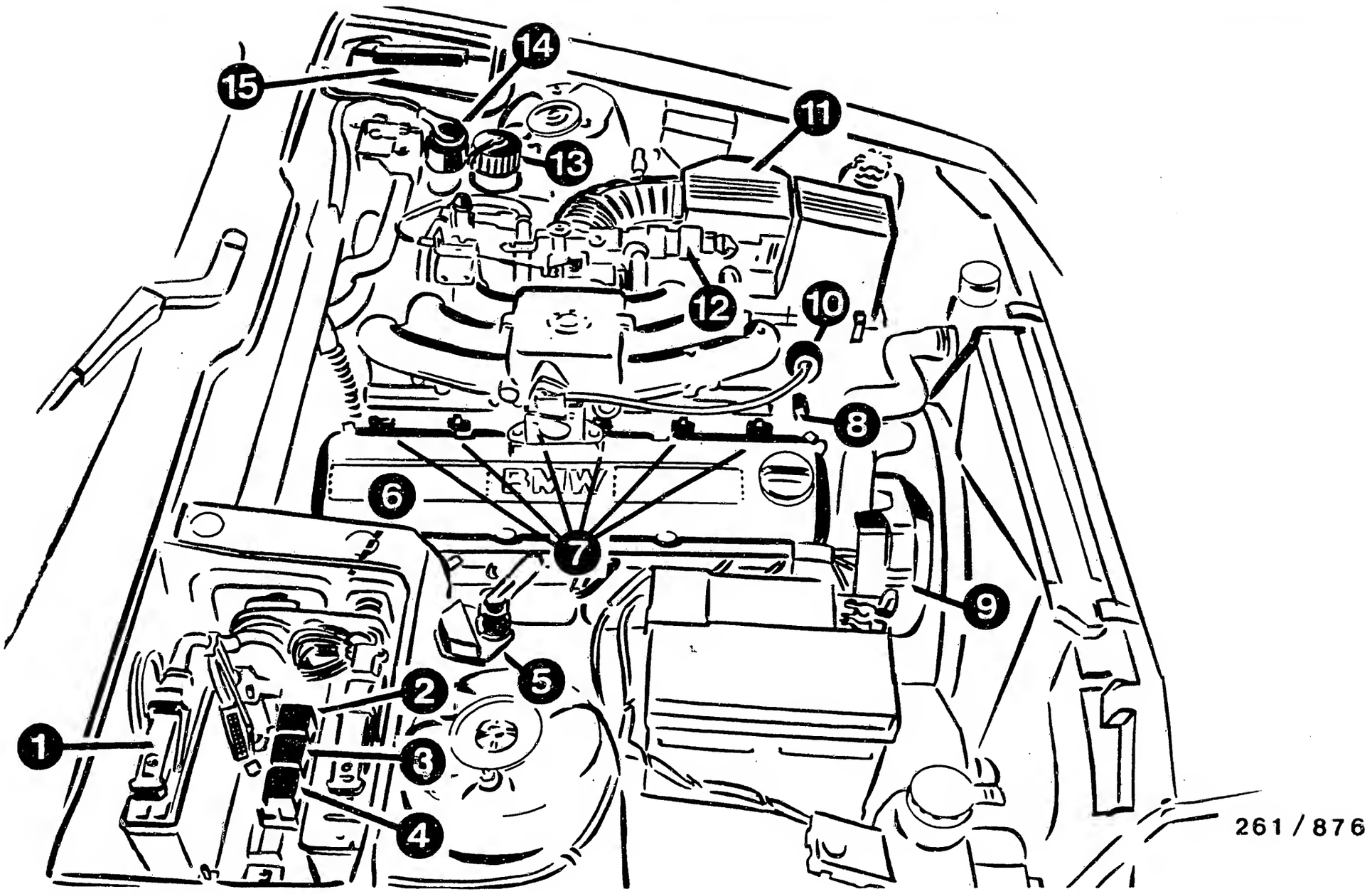
ELECTRICAL TERMINAL DIAGRAM (CONTINUED)

A1 = Transmission control unit (for vehicles with transmission control)
B6 = Throttle-valve switch with potentiometer (for vehicles with transmission control)
H1 = "CARB" lamp (fault lamp; US version only)
P1 = Instrument cluster
P2 = Vehicle computer
S4 = Position switch (automatic transmission only)
T1 = Ignition coil
X1 = Motronic control-unit plug
X2 = Engine plug
X3 = Diagnosis socket
X4 = Jumper in cover
X5 = Plug connection to GS
R1 = Stimulation lead
R2 = Serial interface



INSTALLATION POSITION OF COMPONENTS

1= Motronic control unit
2= Main relay (white)
3= Pump relay (orange)
4= Sensor heater relay (orange)
5= Ignition coil
6= Motronic ground terminal (beneath cover)
7= Solenoid-operated injection valves
8= Temperature sensor (engine)
9= High-voltage distributor
10= Fuel pressure regulator
11= Air-flow sensor
12= Idle actuator
13= Diagnosis socket
14= Engine plug
15= Fuse box

INSTALLATION POSITION OF COMPONENTS (continued)

The installation locations always refer to the direction of travel.

Electric fuel pump:
installed in tank; access via cover in trunk to right of spare wheel.

Fuel filter:
beneath vehicle on right, in front of fuel tank
(top picture, arrow).

Fuse no.23 for electric fuel pump:
in fuse box.

Lambda sensor (for cat.):
in joint exhaust pipe (center picture, arrow).

Plug connection for lambda sensor (round, 4-pole):
at rear left of engine block, beneath starting motor.
Installation position as in 535i (bottom picture, arrows).

Tank ventilation valve (for cat.):
beneath intake manifold.

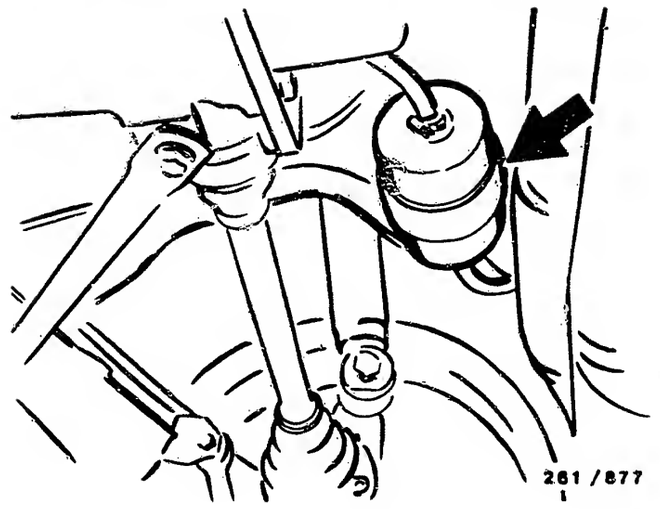
Active-carbon container (for cat.):
in front left of engine compartment.

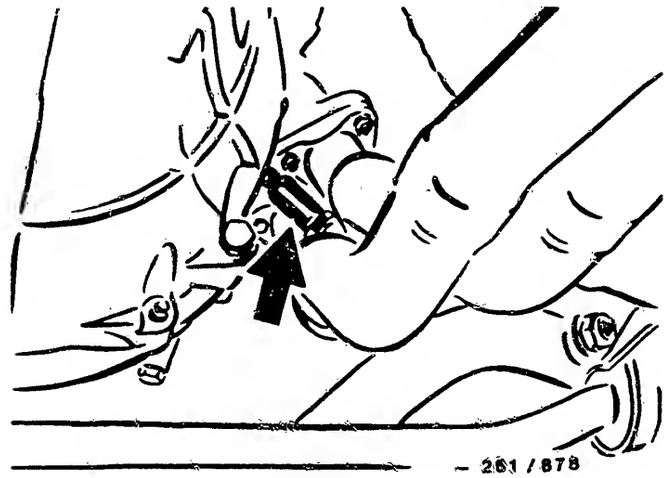
Throttle-valve switch:
at bottom of throttle-valve assembly.

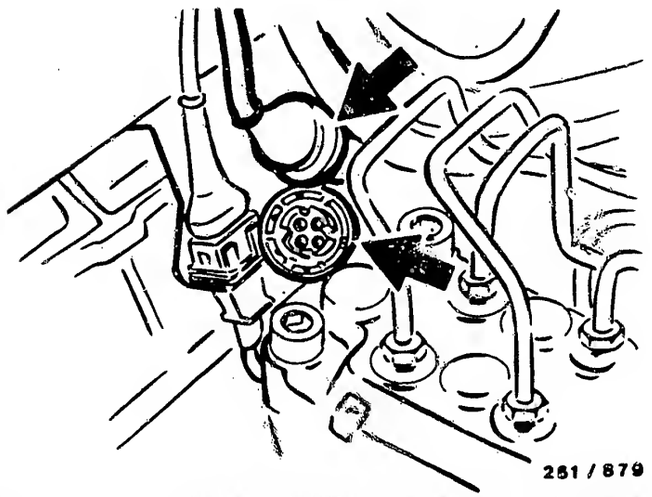
Air temperature sensor:
in air-flow sensor.

Engine-speed/reference-mark sensor:
at front of engine, to right of crankshaft ring gear.

High-voltage sensor:
on high-tension ignition cable to cylinder 6.







Trouble-shooting instructions : ALL-5004

BOSCH system : ABS

TABLE OF CONTENTS

SPECIAL FEATURES

This microcard contains testing and repair instructions for defective ABS warning-lamp diodes.

* This affects all hydraulic modulators with a diode in the relay plug-in frame. The diode is used to actuate the ABS warning lamp.

* Hydraulic modulators with a defective diode in the relay plug-in frame need not be repaired.
There are 3 repair solutions as regards the wiring harness:

  1.Installation of a replacement diode at the wiring-harness-end plug of the hydraulic modulator when the hydraulic-modulator plug is a blade terminal.

  2.Installation of a replacement diode in the ABS controller plug when the hydraulic-modulator plug is a pin terminal (e.g. Kostal plug with DB).

  3.Replacement of diode in plug connection of hydraulic modulator on Citroen and Rolls Royce.

SAFETY AND PRECAUTIONARY MEASURES

* The ABS is a safety system.
  Extreme care is to be taken when performing all work on ABS components and on the ABS wiring harness.
  If repair work is not carried out properly, brake failure may lead to accidents!

* Whenever repairs have been performed, a complete ABS test is to be carried out using the ABS2 LED tester.

* Make sure all connectors of wiring harness are properly attached.

* Never detach or connect ABS wiring-harness plug from controller with ignition switched on.

TESTERS, TOOLS AND SERVICE PARTS

Name	Designation	Part no.
Digital multimeter	e.g. MMD 301	0 684 500 301
Torx socket wrench for Citroen and RR	TX 15	
Diode	BYW 54 Valvo, AEG-Telefunken	8 905 405 432

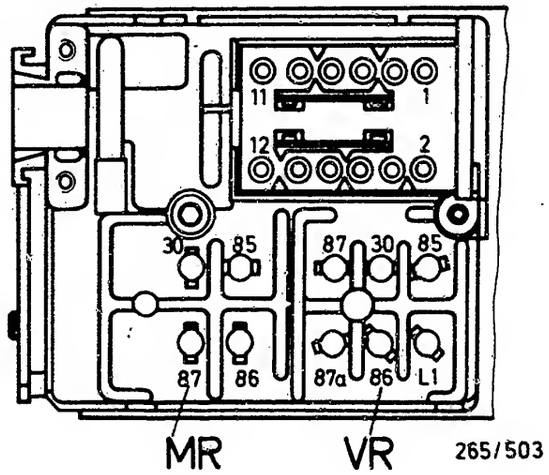
HYDRAULIC MODULATORS AFFECTED

Hydraulic modulators with diode in plug-in frame.

How is it possible to tell whether there is a diode fitted in the plug-in frame?

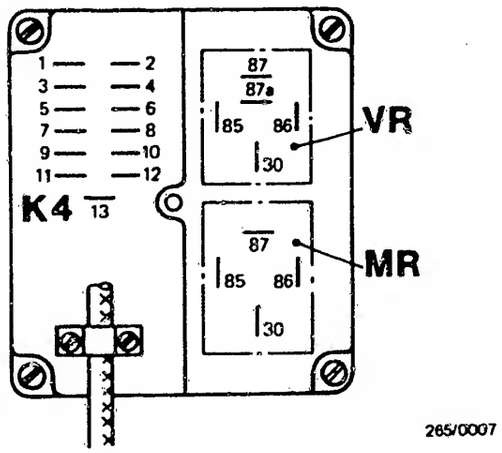
Switch off ignition.
Remove hood from hydraulic modulator.
Detach valve relay.
(Removal information is given in vehicle-specific instructions).

If the plug-in frame has a terminal L 1 for the valve relay, then there is no diode fitted in the plug-in frame. (Diode in valve relay).
If there is no terminal L 1, the diode is fitted in the plug-in frame.
The 3-channel hydraulic modulators for Citroen and Rolls Royce are an exception. In these cases, the diode is fitted in the plug.



Hydraulic-modulator plug-in frame with term. L 1 (bottom right)
MR = Motor relay
VR = Valve relay

Hydraulic-modulator plug-in frame without term. L 1
MR = Motor relay
VR = Valve relay



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N06

DIODE TEST

Before a replacement diode is fitted, the diode installed in the hydraulic modulator or in the plug (Citroen, Rolls Royce) is to be tested using a multimeter (e.g. MMD 301).

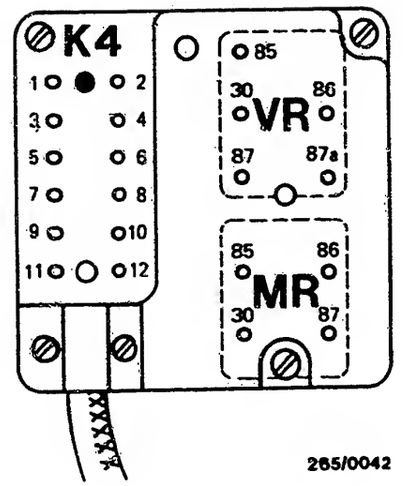
Switch off ignition.
Remove hood.
Detach plug from hydraulic modulator.
Attach test prods to terminals in plug-in frame/plug to which diode is connected.
The corresponding terminals are to be taken from the circuit diagram given in the vehicle-specific instructions. (Example DB: term. 4 and term. 7)

Measurement-mode selector in "diode" setting.

Set values for MMD 301

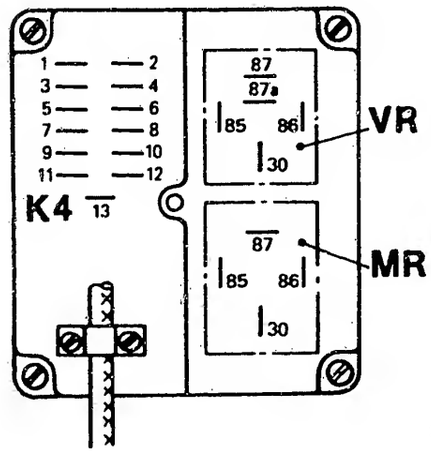
in forward direction: 500...800 mV
in reverse direction: approx. 1500 mV

Please refer to corresponding operating instructions for set values as regards other multimeters.



3-channel hydraulic-modulator plug-in frame
MR = Motor relay
VR = Valve relay
K4 = Wiring-harness plug

4-channel hydraulic-modulator plug-in frame
MR = Motor relay
VR = Valve relay
K4 = Wiring-harness plug



REPAIR SOLUTION 1:

In the case of hydraulic modulators with blade terminals a replacement diode can be fitted as follows:

Ignition off.
Remove hood. Loosen strain-relief clamp for ABS wiring harness and detach plug from hydraulic modulator.

Press back plug catch (top picture) and open up top part of plug (bottom picture).

Use vehicle-specific circuit diagram to determine the terminals to which the diode is connected.

Cut through the lead to the anode of the diode at the plug (e.g. BMW 5 Series: term. 1).
Strip end of lead on wiring-harness end and solder anode of replacement diode (BYW 54) to it.
Note: The cathode of the diode is marked, e.g. with a ring.

Solder the cathode end of the diode to the lead of the other terminal (e.g. BMW 5 Series: term. 3). To do so, strip lead all-round for approx. 5 mm.

Carefully wind insulating tape around bright areas and diode, so as to avoid short-circuits.

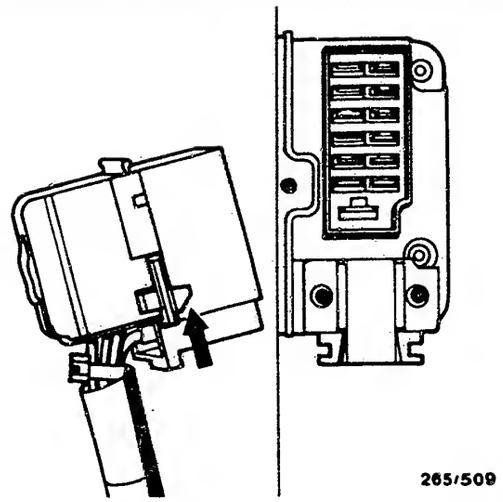
Close top part of plug, attach plug, screw on strain-relief clamp and fit hood.

Check whether warning lamp lights up with controller detached and ignition switched on.

Additionally connect ABS2 LED tester and perform a complete ABS test for safety reasons.

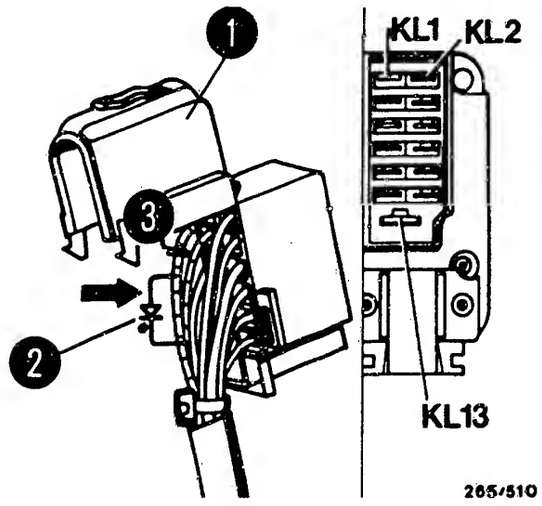
Make workshop repair mark on hydraulic-modulator rating plate between Bosch armature and BOSCH name.

Fill in test report for recording complaints linked to Bosch passenger-vehicle ABS systems and send it to Robert Bosch GmbH, K1/VAK, Robert-Bosch-Str.2 in 7141 Schwieberdingen, West Germany.



Arrow = Catch

Arrow = Anode end
1 = Opened plug
2 = Diode
3 = Cut through lead



REPAIR SOLUTION 2:

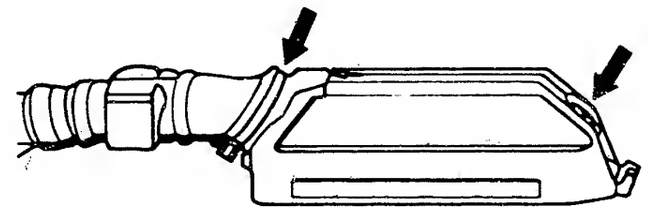
In the case of hydraulic modulators with pin terminals, a replacement diode can be fitted as follows:

Ignition off.
Detach plug from controller.

Open up 35-pole plug:

* Old plug design:
  Remove cable strap and roll back sleeve or vice-versa depending on plug version. Loosen screw and pull out cap.
  Caution ! Fanning strips may drop out.

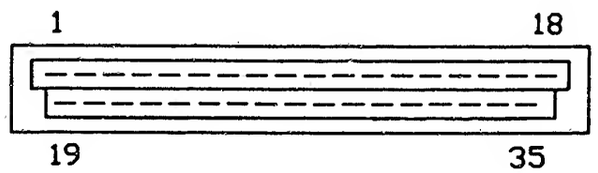
* New plug design:
  Loosen tie band and screw (top picture).
  Roll back rubber sleeve and unscrew strain-relief clamp.
  Remove rubber seal.
  Pull out plug insert with pliers.



265/511

Arrows = Tie band and screw

Top view of 35-pole plug from controller



265/430

Strip leads to term. 29 and term. 32 approx. 5 mm (top picture).

Solder anode end of new diode (BYW 54) to lead to term. 29.
Solder cathode end of diode to lead to term. 32.
Note: The cathode of the diode is marked, e.g. with a ring.

Carefully wind insulating tape around bright areas and diode.

Assemble plug. Do not forget rubber seal and tie band !

To avoid the possibility of any follow-up damage, cut through lead to anode end of built-in diode at plug of hydraulic modulator (bottom picture).
The corresponding terminal is to be taken from the vehicle-specific circuit diagram.

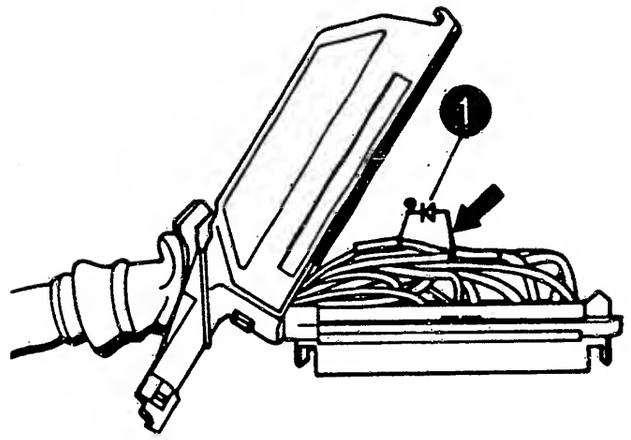
Wind insulating tape around free ends of lead.

Take care when opening plug at hydraulic modulator to ensure that no bushings fall out !
Mixing up leads can have catastrophic consequences for ABS control !

Check whether warning lamp lights up with controller detached and ignition switched on.
Additionally connect ABS2 LED tester and perform a complete test with the ABS2 LED tester for safety reasons.

Make workshop repair mark on hydraulic-modulator rating plate between Bosch armature and BOSCH name.

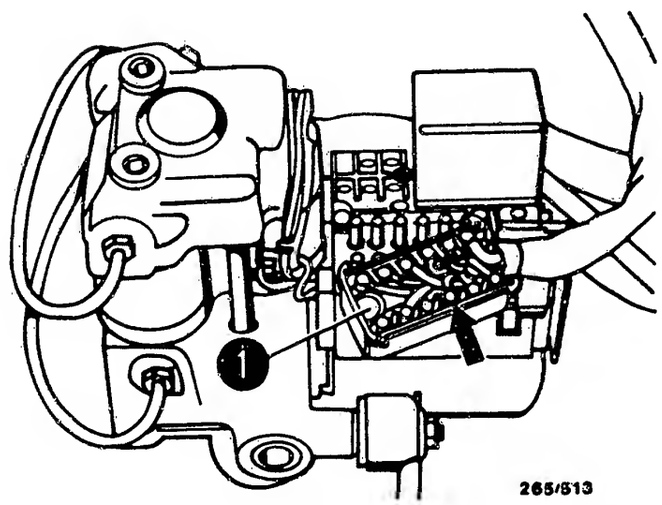
Fill in test report for recording complaints linked to Bosch passenger-vehicle ABS systems and send it to Robert Bosch GmbH, K1/VAK, Robert-Bosch-Str.2 in 7141 Schwieberdingen, West Germany.



265/512

Arrow = Anode end (term. 29)
1 = Diode

Arrow = Disconnection point for lead (example only!)
1 = Opened plug of 3-channel hydraulic modulator



265/513

REPAIR SOLUTION 3:

For 3-channel hydraulic modulators installed in Citroen and Rolls Royce vehicles.

Ignition off.
Detach plug connection of hydraulic modulator with Torx socket wrench TX 15.
Pull out and detach plug connection.

Push wire (e.g. paper clip) through blade contacts and bend over at ends to prevent contacts falling out on opening (see top picture).

Mixing up leads can have catastrophic consequences for ABS control !

Open base of plug. To do so, raise catches somewhat with screwdriver.

Pinch off defective diode. Leave approx. 5 mm of wire.
Solder new diode (BYW 54) with correct polarity to ends of wires.
Solder anode of diode to plug term. 1.
Note: The cathode of the diode is marked, e.g. with a ring.

Assemble plug, re-attach it and install.

Check whether warning lamp lights up with controller detached and ignition switched on.
Additionally connect ABS2 LED tester and perform complete test with ABS2 LED tester for safety reasons.

Make workshop repair mark on hydraulic-modulator rating plate between Bosch armature and BOSCH name.

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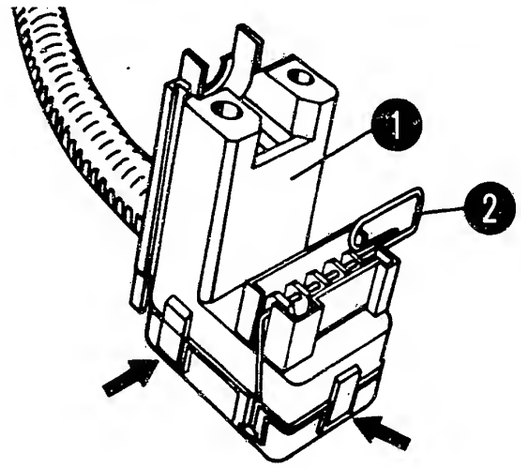
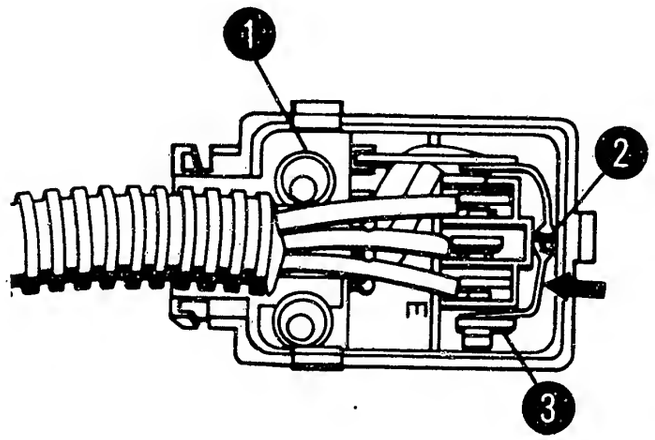


265/514

Arrows = Latches
1 = Plug housing
2 = Wire (paper clip)

Arrow = Anode end
1 = Opened plug housing
2 = Diode
3 = Terminal 1



265/515